United States Department of Agriculture

Soil Conservation Service

In Cooperation with Minnesota Agricultural Experiment Station

Soil Survey of Houston County, Minnesota

HOW TO USE

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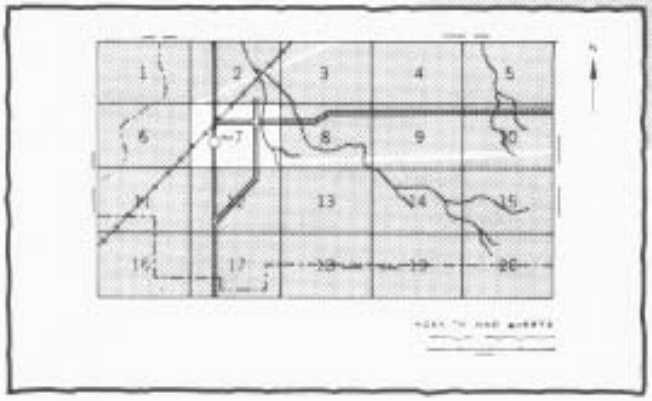

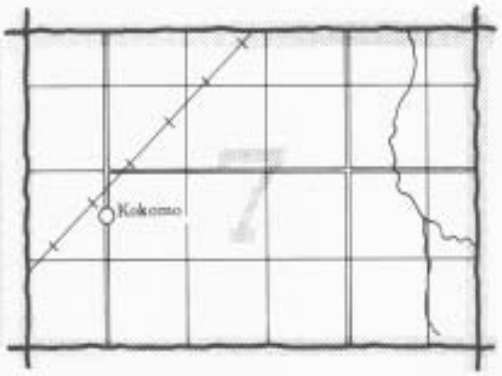

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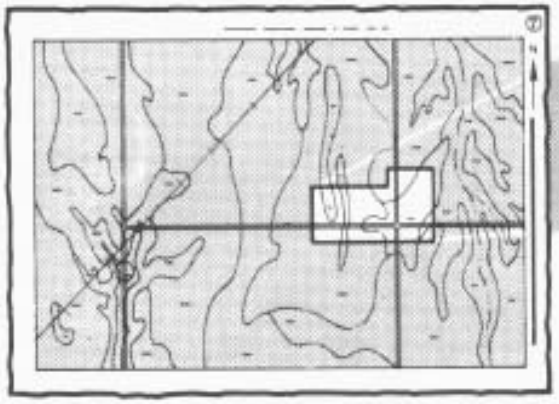

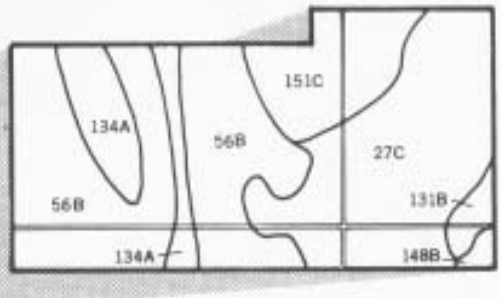

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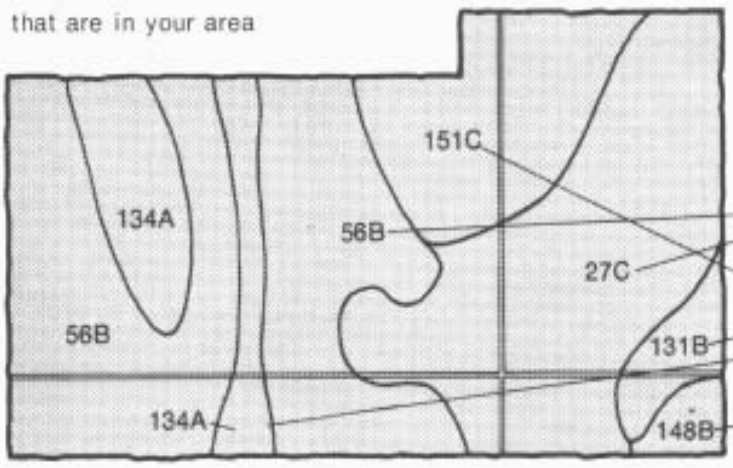

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THIS SOIL SURVEY

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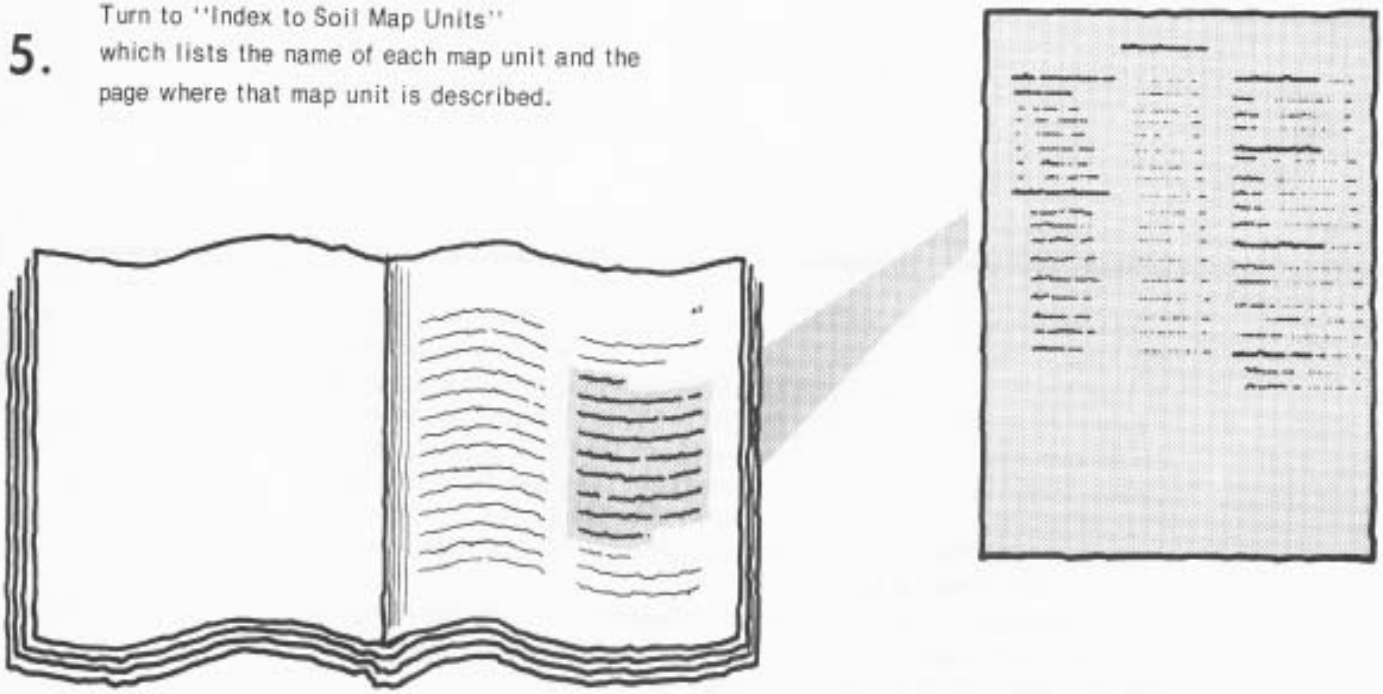
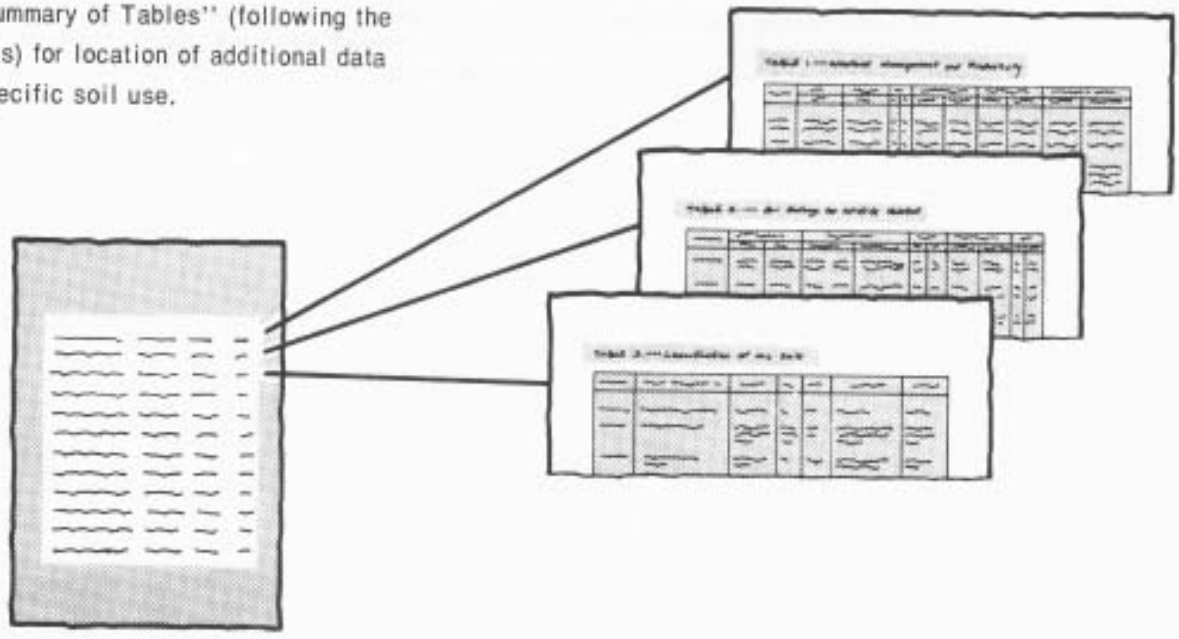


6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture, Soil Conservation Service, and the Minnesota Agricultural Experiment Station in cooperation with the Agricultural Extension Service, the Soil and Water Conservation Board, and the Houston County Soil and Water Conservation District. The survey was partially funded by the Legislative Commission for Minnesota Resources and Houston County. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1976-80 Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: A farm pond on Eitzen silt loam, 1 to 6 percent slopes, channeled, provides water for livestock and protects the soils at a lower elevation from flooding. The Etter-Brodale complex, rocky, 25 to 50 percent slopes, is in the wooded areas.

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Foreword

This soil survey contains information that can be used in land-planning programs in Houston County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Donald G. Ferren
State Conservationist
Soil Conservation Service

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Soil Survey of
Houston County, Minnesota

By Robert A. Lueth, Soil Conservation Service
Fieldwork by David L. Aldeen, Greg Harding, John C. Jacobson, George A. Poch, and Robert A. Lueth, Soil Conservation Service, and Brian C. Hargraves, Minnesota Agricultural Experiment Station

United States Department of Agriculture, Soil Conservation Service
in cooperation with Minnesota Agricultural Experiment Station

HOUSTON COUNTY is in the southeast corner of the state. It has an area of about 570 square miles or 364,800 acres. Caledonia, the county seat, is near the center of the county (fig. 1).

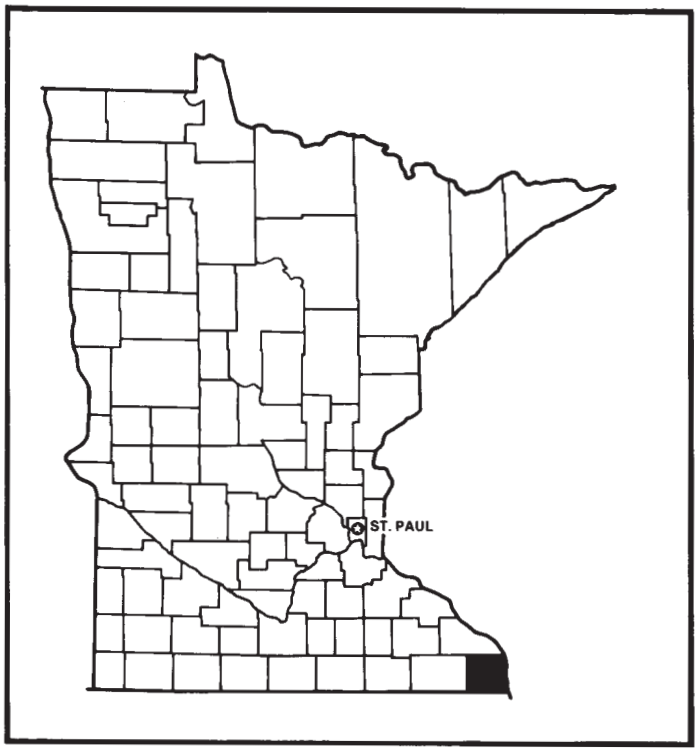

Figure 1.—Location of Houston County in Minnesota.

Dairy farming is the main livestock enterprise in the county. Beef and hog raising are important enterprises also. Beef enterprises consist of cow-calf and feeder operations. The climate is well suited to commonly grown crops, such as corn, alfalfa, grasses, and oats. Apples are an important crop in the northeastern part of the county. Small industries include food processing and a metal plating industry.

An older soil survey of Houston County was published in 1929 (*13*). This survey was a broad generalized survey. The present survey provides additional information and larger maps that show the soils in greater detail.

Descriptions, names, and delineations of soils do not agree fully with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, and the extent of soils within the survey.

Soil scientists were denied access to a few tracts in the county. These areas were mapped by using knowledge of the surrounding area and aerial photo interpretation. Delineations portraying soil boundaries are less accurately drawn on these tracts than where soil scientists had access to the land and could examine the soils.

General Nature of the County

This section gives general information about the county. It describes climate, history and development, transportation and markets, farming, water supply, and physiography, relief, and drainage.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Houston County is cold in winter and is quite hot with occasional cool spells in summer. During the winter precipitation frequently occurs as snowstorms, and during the warm months it is chiefly showers, often heavy, when warm moist air moves in from the south. Total annual rainfall is normally adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Caledonia, Minnesota, in the period 1957 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 17 degrees F, and the average daily minimum temperature is 7 degrees. The lowest temperature on record, which occurred at Caledonia on January 15, 1963, is -37 degrees. In summer the average temperature is 68 degrees, and the average daily maximum temperature is 80 degrees. The highest recorded temperature, which occurred on June 30, 1970, is 96 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 24 inches, or 71 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.02 inches at Caledonia on August 3, 1959. Thunderstorms occur on about 42 days each year, and most occur in summer.

The average seasonal snowfall is 42 inches. The greatest snow depth at any one time during the period of record was 37 inches. On an average of 55 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 65 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The prevailing wind is from the northwest. Average windspeed is highest, 12 miles per hour, in April.

Tornadoes and severe thunderstorms strike occasionally. These storms are local and of short duration and result in sparse damage in narrow belts. Hailstorms occur at times during the warmer part of the year in irregular patterns and in relatively small areas.

History and Development

Originally, the Winnebago Indians occupied the survey area (*18*). The first settlers came into the area late in the winter of 1848 at Wildcat Bluff, which later became known as Brownsville. Houston County was separated from Fillmore County in 1854. In that same year, Caledonia was established as the county seat.

Predominantly, the earliest settlers were largely Irish. Norwegians settled in the western and southwestern parts of the county near Spring Grove. Germans settled near Eitzen and the northern part of the county. Luxemburgers settled around Caledonia and Freeburg (*13*). The towns, townships, and physiographical features were named after people, places in Europe, or plants or animals in the area. In the 1930's the population of the county was 13,845. In 1979 the population of Houston County was 18,200.

Transportation and Markets

One railroad serves the county. It follows the Mississippi River from north to south and serves the towns of La Crescent, Brownsville, and New Albin.

Most of the major highways are paved or blacktopped. U.S. Highway 16 crosses the county from east to west along the Root River. State Highway 76 crosses the county in a north-south direction and intersects U.S. Highway 16 at Houston. State Highway 44 crosses the county diagonally. It enters the southwestern part of the county and leaves in the eastern part at Hokah. State Highway 26 parallels the Mississippi River, crossing the eastern edge of the county in a north-south direction. Some county roads are blacktopped, but most county roads and the township roads serving the farms are gravelled.

Livestock generally are taken by truck to St. Paul in Ramsey County or to La Crosse, Wisconsin. Most of the milk produced is shipped by truck.

Farming

Farming in Houston County has passed through several periods in which different systems of farming were tried and abandoned. During the pioneer period, nearly all products were consumed at home. In the mid 1860's, wheat growing became profitable because of the rapid development of farm machinery and the increased demand for food stimulated by the Civil War (*13*). For several years wheat was the only crop grown on some farms. During this time Brownsville was an important shipping center, receiving wheat from as far as 50 miles inland. Wheat growing was nearly discontinued by the end of the 1880's due to crop losses from disease and insect damage.

After the decline of wheat as a main crop, hog raising became the major farming enterprise. Corn grown in

large fields was not well suited to the highly erodible sloping soils. Corn growing during this period involved intensive tilling of the soil to prepare a seedbed and many cultivations to control weeds (*10*). The resulting loss of organic matter, poor soil tilth, and large fields of exposed soil led to severe gully erosion. Erosion was so severe that some fields were abandoned.

Dairy farming began in the 1890's but did not become important until about 1910. Dairying and beef production are well suited to the sloping to very steep topography. Dairying largely utilizes the more productive soils on the summits and upper side slopes of the ridgetops. Forage crops are fed in large amounts to dairy cattle. These crops are very productive on the silty soils; at the same time forage crops provide a cover of sod that protects the soil from erosion. Relatively large areas are too steep for cropland but are suitable for pasture that supports beef cattle enterprises.

Today's system of livestock farming is basically in harmony with the climatic and soil conditions in the county. Since 1935, conservation practices have been applied to most farms. Most ridgetop farms have contour strips. Gullies have been filled, shaped, and seeded to grassed waterways. Terraces are also used on some farms. These practices, along with diversions and dams that have been built, help reduce flooding in the valleys.

Corn and hay are presently the most important crops grown in Houston County. In 1977, 68,000 acres of corn was planted to grain or silage, 57,300 acres to hay, 16,400 acres to small grain, and 2,800 acres to soybeans.

Livestock numbers have been increasing steadily in Houston County. In 1977, 91,600 head of cattle and calves were in the county, of which 17,600 were dairy cows. Additionally, there were 140,600 hogs, 55,000 chickens, and 500 sheep.

In 1977, there were 1,395 farms in the county. The average farm was 237 acres. Approximately 165,000 acres were used as cropland (*17*).

Water Supply

The water supply is drawn from a number of the many strata or formations below the mantle of loess and erosional sediment (*12*). The Jordan sandstone is the major source of water for communities on the upland. In the deep valleys cut below the Jordan sandstone, the main source of water is the Dresbach Formation. Other formations provide limited amounts of water. The loess and erosional sediments are too thin to furnish a dependable water supply. In some places in deep valleys, water for farm use is taken from the alluvial fill.

Small amounts of water are available from the St. Peter sandstone, which is the lowest bedrock unit on the high narrow ridge in the southwestern part of the county. Because water escapes easily to the surrounding lowlands, this water supply is not sufficient for industrial uses.

The Shakopee and Oneota Formations below the St. Peter sandstone contain water in joints and solution passages but do not generally afford adequate supplies for home and farm uses. The New Richmond sandstone, a member of the Shakopee Formation, furnishes water for home and farm uses in a few places but not in quantities suitable for municipal or industrial use.

The Jordan sandstone yields abundant supplies of water, except near outcrops where water escapes to the valleys below. This formation furnishes water to the towns of Caledonia and Spring Grove.

The St. Laurence and Franconia Formations below the Jordan sandstone have little importance as a source of water. Most farms and communities lying below the level of the Jordan sandstone have drilled wells through the St. Laurence and Franconia Formations. They take their water from the Dresbach Formation consisting of sandstone and shales. The Galeville sandstone, Mt. Simon sandstone, and the Dresbach Formation are the most dependable sources of water in the county. The towns of Hokah and La Crescent and other small communities along the Mississippi River obtain their water supply from rivers and streams. The water from the Jordan sandstone is very hard, containing large amounts of lime and iron. Water supplies from the Dresbach Formation contain smaller amounts of these elements.

Physiography, Relief, and Drainage

Houston County is at the western edge of the driftless region of the upper Mississippi valley. There is evidence that the western part of the county was glaciated, but only a few small patches of drift in the northwestern corner of the county are preserved.

Houston County has the most rugged topography of any county in the southern part of Minnesota. Differences in elevations between ridgetops and flood plains range to as much as 600 feet. Extremes in elevation range from 1,322 feet near Spring Grove to 636 feet at Reno.

The uplands consist of a high narrow ridge and a lower lying dissected plain. The ridge and plain consist of sedimentary rock deposited in former inland seas. The bedrock has a mantle of loamy to clayey erosional sediment on its surface in most places. This is blanketed by a mantle of loess that covers all but the steep to very steep slopes along rivers and creeks.

The ridge is in the southwestern and west-central parts of the county. Spring Grove is near the center of the ridge. Narrow spurs radiate from the main ridge, which is dissected in places into low mesa-shaped hills. Slopes are 200 to 300 feet in length and are smooth.

The lower lying plain makes up most of the county. This formerly nearly level plain has been carved into an

intricate pattern of deep valleys and ridges. Slopes are long and smooth. Slopes along creeks and rivers are steep to very steep and make up about 40 percent of the county. Some of the major creeks originate in the south-central part of the county. Here the landscape is less dissected. Creeks are less incised and ridges are broader than in the eastern and northern parts of the county.

The valleys formed by the dissection of the plain have terraces along the major creeks and streams. Terraces range from a few feet to as many as 80 feet above the valley floor. The terraces are nearly level to gently sloping and have short to very steep slopes that lead to the flood plain below.

The landforms in Houston County have no natural depressions of significance to trap runoff. The runoff that cannot be absorbed by the soil drains into the many creeks which lead to three major rivers. Most creeks flow into the Root and Mississippi Rivers. Creeks in the south-central and southwestern parts of the county flow into the upper part of the Iowa River. The Iowa and the Root Rivers discharge into the Mississippi River.

How This Survey Was Made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General Soil Map Units" and "Detailed Soil Map Units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

General Soil Map Units

The general soil map at the back of this publication shows broad areas called soil associations that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Nearly Level to Sloping Soils Formed Mostly in Loess on Uplands

These well drained and moderately well drained soils formed mainly in wind-deposited silty materials. They formed under tall grass prairie and mixed hardwood forest. Most areas of these soils are used for cropland. Some areas are used for pasture and homesites. Where management is good, these soils are well suited to farming. The hazard of erosion is the main management concern. Steeper slopes can be managed for pasture and woodland. The two associations in this group make up about 20 percent of the survey area.

1. Mt. Carroll-Port Byron Association

Nearly level to sloping, well drained and moderately well drained, silty soils; on tops and crests of ridges

This association consists of broad upland ridges at the upper reaches of the drainage system. The ridgetops are dominantly 1/2 to 1 1/2 miles wide and have broad summits. Slopes are long and smooth and are dominantly 1 to 12 percent but range to 20 percent.

This association makes up about 17 percent of the county (fig. 2). It is about 29 percent Mt. Carroll soils and 22 percent Port Byron soils. The rest is soils of minor extent.

Mt. Carroll soils are on ridgetops and are gently sloping and sloping. The surface layer is very dark grayish brown silt loam. The subsoil is dark yellowish brown and yellowish brown silt loam. The underlying material is brown silt loam.

Port Byron soils typically are on ridgetops and are nearly level to sloping. The surface layer is black silt loam. The subsoil is dark yellowish brown, yellowish brown, and light olive brown silt loam. The underlying material is light olive brown silt loam.

Of minor extent are the well drained and moderately well drained Eitzen soils in drainageways, the well drained Blackhammer, Nodine, Rollingstone, Newhouse, and Valton soils on the ridgetops, and the well drained Lamoille soils on the sides of ridges. The well drained Lindstrom soils are on foot slopes below narrow ridges, and the somewhat poorly drained Muscatine soils are in drainageways.

The soils in this association are very productive. The nearly level to gently sloping soils near the ridge summits are used mainly for growing corn. A small acreage, however, is used for soybeans and forage crops. Included areas of sloping to moderately steep soils are used for corn, forage crops, and small grain. The hazard of erosion is the main limitation to row crops. Slopes are long, and the soil is easily eroded. Tillage methods that leave large amounts of residue on the surface, contour stripcropping, and terraces are well suited to the nearly level to moderately sloping soils. Gullies form easily in the narrow drains that cross these soils, unless the drains are seeded and maintained as grassed waterways.

The included areas of strongly sloping to moderately steep soils along the drainageways are used mostly for forage crops or pasture. Ponds constructed in the drainageways help control runoff and provide water for livestock.

2. Seaton Association

Gently sloping to sloping, well drained, silty soils; on tops of ridges

This association consists of broad upland ridges at the upper reaches of the drainage system. The summits of ridges are about 1/4 to 3/4 mile wide. Slopes are long and smooth and are dominantly 3 to 12 percent but range to 30 percent.

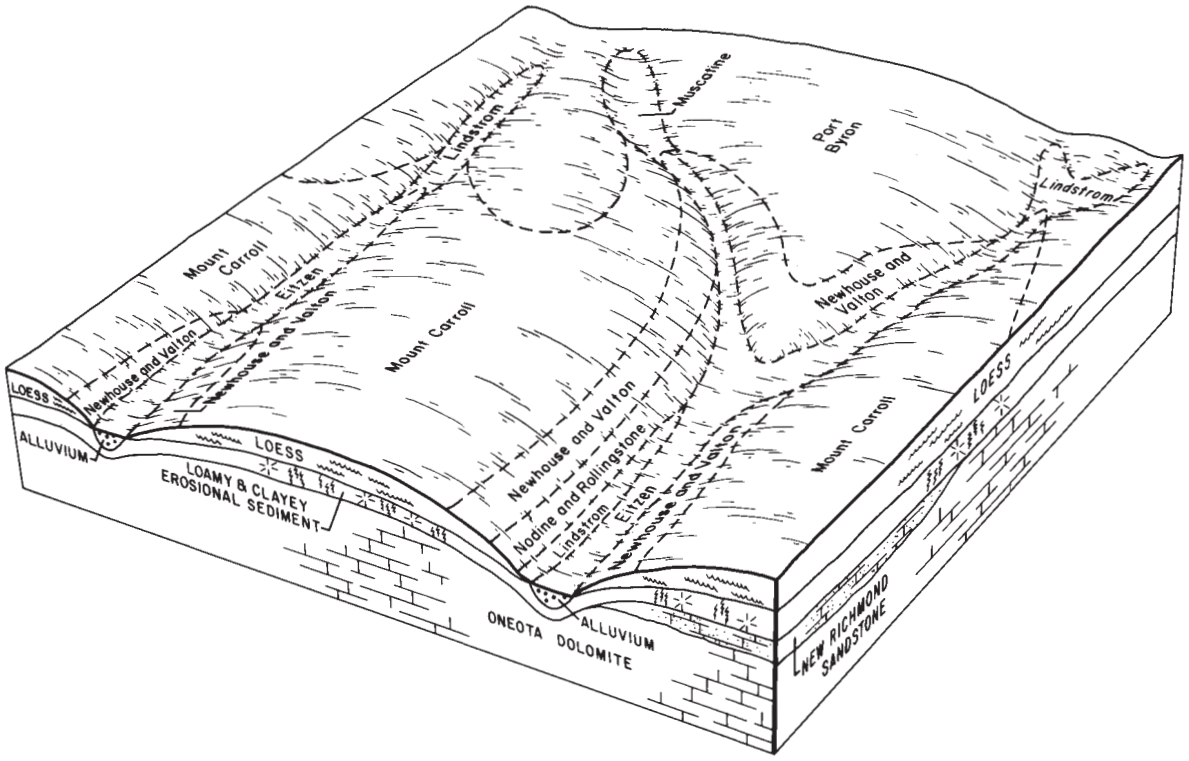

Figure 2.—Pattern of soils and underlying material in the Mt. Carroll-Port Byron Association.

This association makes up about 3 percent of the county. It is about 90 percent Seaton soils. The rest is soils of minor extent.

Seaton soils are on the ridgetops. The surface layer is dark grayish brown silt loam. The subsoil is dark yellowish brown silt loam. The underlying material is brown silt loam.

Of minor extent are the well drained Blackhammer, Nodine, Rollingstone, and Southridge soils on the ridgetops. They commonly are downslope from the Seaton soils. Chaseburg soils are in drainageways that dissect areas of this association.

Nearly all of the soils in this association have been cleared and are used for cropland. These soils are very productive. Corn and forage crops are mainly grown. The hazard of erosion is the main limitation to row crops. Maintaining a friable condition in the surface soil is difficult because of the low content of organic matter. Terraces, contour stripcropping, and tillage methods that leave large amounts of crop residue on the surface are well suited to these soils and help to control erosion. Gullies develop easily unless drainageways crossing the slopes are maintained as grassed waterways.

Some included areas of strongly sloping and moderately steep soils are used for pasture. Ponds constructed in narrow drainageways provide water for livestock and help reduce runoff.

Sloping to Moderately Steep Soils Formed Mostly in Loess and in Loess and Underlying Erosional Sediment on Uplands

These well drained soils formed in wind-deposited silty material and in silty material and the underlying loamy to clayey erosional sediment. They formed under mixed hardwood forest. Most areas of these soils are used by dairy and beef cattle farms that utilize large amounts of forage. Some areas, particularly where slopes are moderately steep, are used for pasture and woodland. The hazard of erosion is the main management concern. These soils make up about 16 percent of the survey area.

3. Seaton-Blackhammer-Southridge Association

Sloping to moderately steep, well drained, silty soils; on tops of ridges

This association consists of upland ridges and is mainly in the northern and eastern parts of the county. Most ridgetops are 1/8 to 1/2 mile wide and are separated by broad valleys. Slopes are long and smooth and range from 3 to 20 percent.

This association makes up about 16 percent of the county (fig. 3). It is about 54 percent Seaton soils, 21 percent Blackhammer soils, and 17 percent Southridge soils. The rest is soils of minor extent.

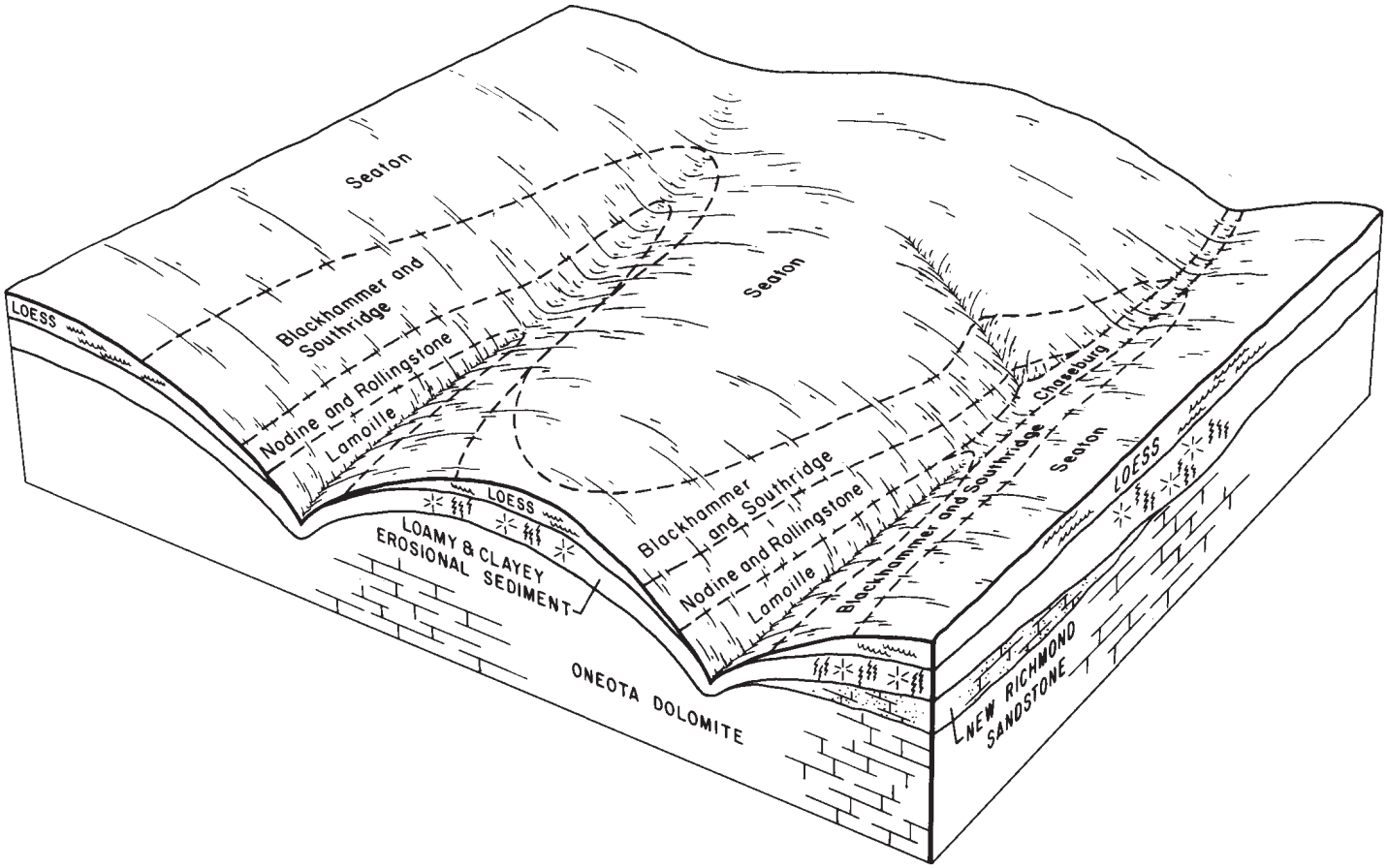

Figure 3.—Pattern of soils and underlying material in the Seaton-Blackhammer-Southridge Association.

Seaton soils are mainly on or near the summits. The surface layer is dark grayish brown silt loam. The subsoil is dark yellowish brown silt loam. The underlying material is brown silt loam.

Blackhammer soils typically are below the summits. The surface layer is dark grayish brown silt loam. The upper part of the subsoil is yellowish brown silt loam, and the lower part is stratified strong brown, reddish yellow, yellowish red, and reddish brown clay loam, sandy clay loam, sandy loam, loamy sand, and sand.

Southridge soils are on positions similar to those of Blackhammer soils. The surface layer is dark grayish brown silt loam. The upper part of the subsoil is yellowish brown silt loam, and the lower part is reddish brown clay.

Of minor extent are the well drained, moderately steep Lamoille soils on the upper sides of ridges and the gently sloping to strongly sloping Nodine and Rollingstone soils on the ridgetops, dominantly on north to northwest aspects. The well drained and moderately well drained Chaseburg soils are in narrow drainageways that cross areas of this association.

Nearly all areas of this association have been cleared. The soils are productive if properly managed. The common crops are corn for grain and silage, forage crops, and small grain. The hazard of erosion is the main limitation to row crops, such as corn. Maintenance of a friable surface layer is an additional management concern on all the soils. Contour stripcropping and tillage methods that maintain large amounts of crop residue on the surface are well suited to these soils (fig. 4). Gullies develop easily unless drainageways crossing the slopes are maintained as grassed waterways.

Some included areas of sloping and moderately steep soils are used for pasture. Overgrazing is a management concern. Overgrazing and grazing when the soils are too wet reduce yields and cause gullies to form in the highly erodible soils. Ponds constructed in narrow drainageways provide water for livestock and help control runoff.

Small, mainly irregular-shaped areas on the ends of ridges are used for woodland. They are well suited to trees. New plantings are difficult to establish because of severe plant competition. There are no important harvesting limitations.

Figure 4.—Contour stripcropping in an area of Seaton-Blackhammer-Southridge Association.

Steep and Very Steep Soils Formed Mostly in Loess Mantled Erosional Sediment and in Colluvium on Uplands

These well drained soils formed mainly in a thin mantle of loess and the underlying very cobbly clayey sediment or very cobbly loamy colluvium. They formed under prairie grasses and hardwood trees. Most areas of these soils are used for woodland, but some are used for pasture. The main management concerns are the steepness of slope and the hazard of erosion. Small areas that are not so sloping are used for cropland. These soils make up about 33 percent of the survey area.

4. Lamoille-Lacrescent Association

Steep and very steep, well drained, silty soils; on the sides of ridges

This association is on the sides of ridges that flank the terraces and flood plains along the many creeks and rivers in the county. Slopes are 300 to 600 feet in length. They are smooth, and most are plane or convex. Many narrow gullies and drainageways cross areas of this association. Slope ranges from 20 to 70 percent.

This association makes up about 33 percent of the county (fig. 5). It is about 32 percent Lamoille soils and 24 percent Lacrescent soils. The rest is soils of minor extent.

The Lamoille soils are on the upper part of side slopes near the ridgetops and are steep and very steep. The surface layer is very dark grayish brown silt loam. The subsurface layer is dark grayish brown silt loam. The upper part of the subsoil is reddish brown clay, and the lower part is brown very cobbly clay loam. The underlying material is yellowish brown very cobbly loam. Dolomitic limestone is at a depth of 40 to 100 inches or more.

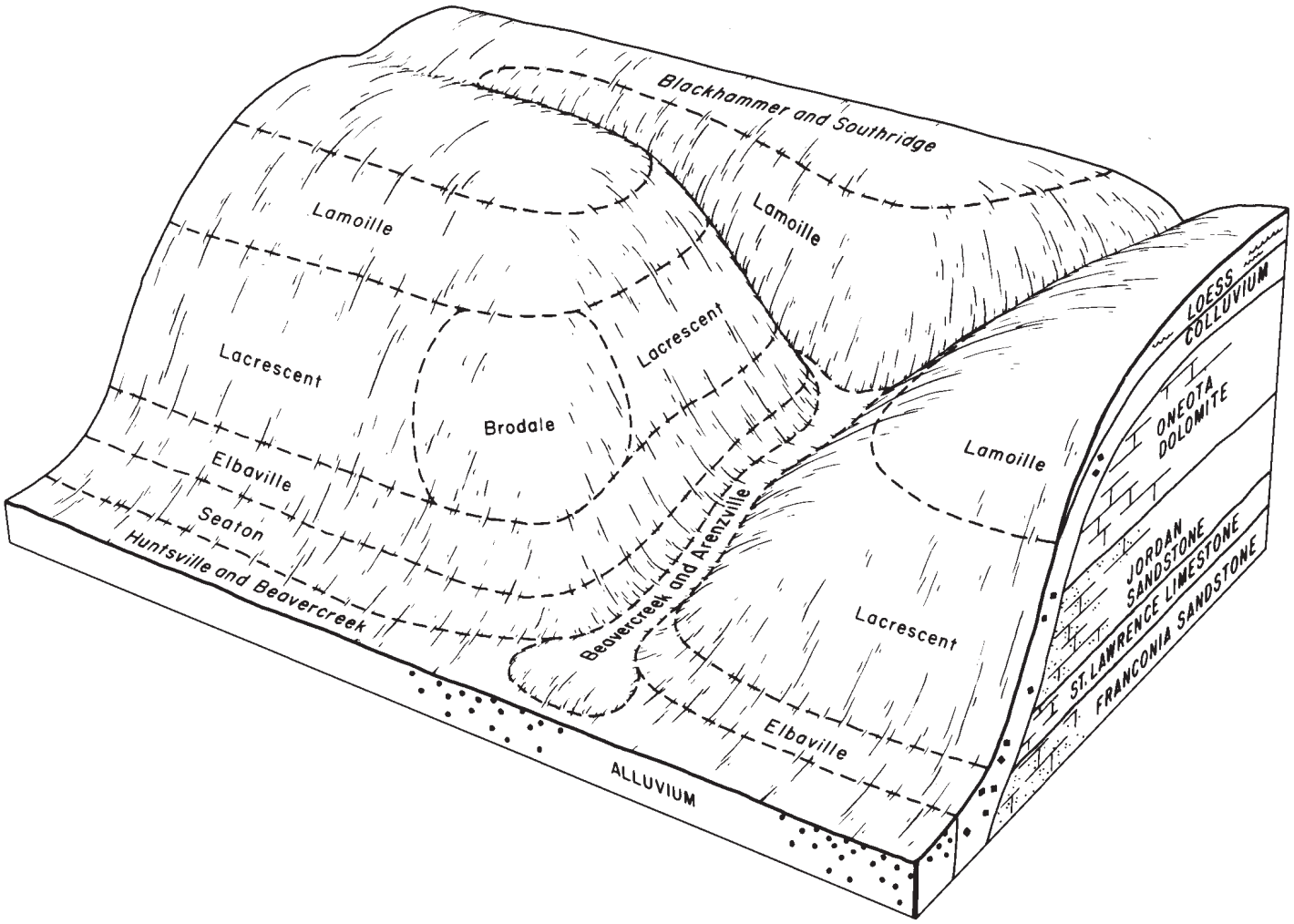

Figure 5.—Pattern of soils and underlying material in the Lamoille-Lacrescent Association.

Lacrescent soils are downslope from the Lamoille soils and are very steep. The surface layer is black cobbly silt loam. The subsoil is dark brown very cobbly silt loam. The underlying material is light olive brown very cobbly silt loam. Dolomite limestone or sandstone is at a depth of 40 inches or more.

Of minor extent are the well drained Blackhammer, Nodine, Rollingstone, Seaton, and Southbridge soils on narrow ridgetops, the excessively drained Brodale soils and the well drained Dorerton soils on the side of ridges, and the well drained Elbaville and Seaton soils on foot slopes. The moderately well drained to somewhat excessively drained Beavercreek soils and the well drained Huntsville soils are in narrow drainageways.

Most areas of this association are in woodland, but the south- and west-facing noses of ridges along the narrow flood plains and the south- and west-facing side slopes along the wider flood plains support natural prairie vegetation. This plant community is gradually being encroached upon by redcedars and oaks from nearby sites that have more moisture. The wooded side slopes consist mainly of oak and hickory. Productivity is low to moderate because of the low to moderate available water capacity. The steep slopes hamper the use of logging equipment. Erosion is a hazard along logging roads and skid trails.

Small areas, particularly those on the upper part of side slopes, are used for pasture. Maintaining the pasture in good condition and preventing overgrazing are the main management concerns. Where the soils are not too sloping and can be managed, pasture can be improved by seeding the existing bluegrass to more productive species.

Small scattered tracts included with this association are used for cropland. Most cropped areas consist of narrow, moderately sloping to strongly sloping ridges. The hazards of erosion and droughtiness are the main concerns in using these soils for row crops.

Gently Sloping to Very Steep Soils Formed Mostly in Loess and in Loess and Bedrock Residuum on Uplands

These well drained soils formed mainly in wind-deposited silty materials of variable thickness and in underlying bedrock residuum on ridgetops. The soils formed mostly under tall grass prairie and mixed hardwood forest. Areas are used for farming, pasture, and homesites. The main management concern is the hazard of erosion. These soils make up about 5 percent of the survey area.

5. Mt. Carroll-Frankville Association

Gently sloping to steep, well drained, silty soils; on narrow ridges

This association consists of a narrow upland ridge on the higher elevations in the county. The village of Spring Grove is near the center of the ridge. In places geological erosion has worn through the ridge, leaving a few isolated mesalike hills, which are also part of this association. The ridge is mostly 1/8 to 1/2 mile wide. Slopes are long and smooth. Slope ranges from 3 to 20 percent on the ridgetops and from 20 to 50 percent on the side slopes.

This association makes up about 5 percent of the county (fig. 6). It is about 23 percent Mt. Carroll soils and 14 percent Frankville soils. The rest is soils of minor extent.

Mt. Carroll soils typically are near the ridge summits and are gently sloping to sloping. The surface layer is very dark grayish brown silt loam. The subsoil is dark yellowish brown and yellowish brown silt loam. The underlying material is brown silt loam.

Frankville soils are on the ridgetops and are gently sloping to steep. The surface layer is black silt loam. The upper part of the subsoil is dark yellowish brown silt loam, and the lower part is dark brown silty clay and very flaggy silty clay. Limestone bedrock is at a depth of 40 to 80 inches.

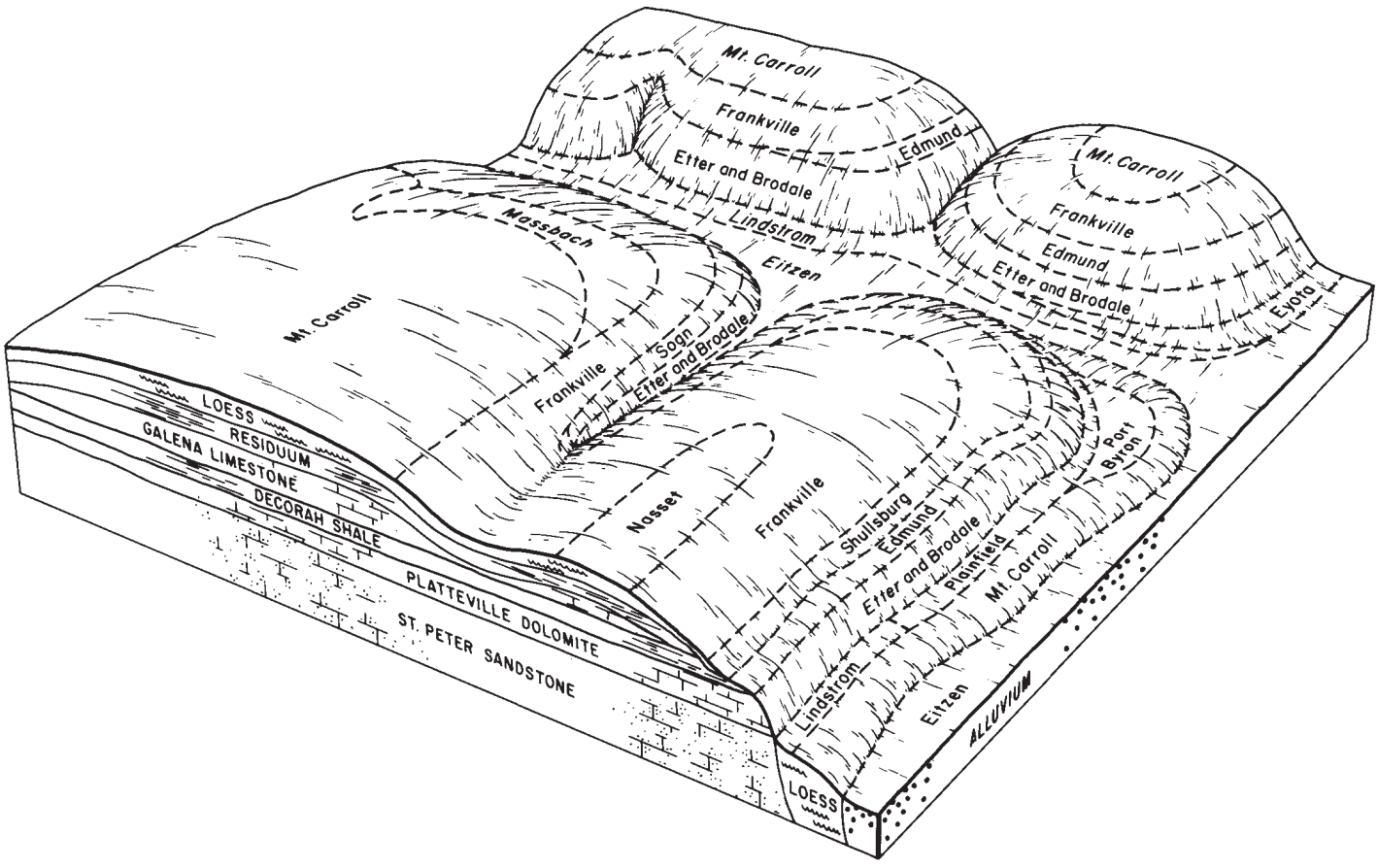

Figure 6.—Pattern of soils and underlying material in the Mt. Carroll-Frankville Association.

Of minor extent on the tops of ridges are the somewhat excessively drained Sogn soils, the well drained Edmund and Nasset soils, the well drained and moderately well drained Massbach, Port Byron, and Seaton soils, and the somewhat poorly drained Shullsburg soils. The excessively drained Brodale soils and the well drained Lacrescent soils are on the side slopes of ridges. The well drained Etter soils are on the steep and very steep side slopes of ridges. The well drained Eyota and Lindstrom soils and the somewhat excessively drained Plainfield Variant soils are on foot slopes below the ridges. The well drained and moderately well drained Eitzen soils are in narrow drainageways that dissect the ridges.

Most areas of this association, except some areas on moderately steep to steep side slopes, have been cleared and are used for cropland or pasture. Corn is the major crop grown on the gently sloping broader part of the summits where the soils are deep and available water capacity is high or very high. The sloping and moderately sloping soils downslope are used for corn and forage crops. The shallow soils near the ends of the ridges are used for forage crops and pasture. Most of the ridge side slopes are in pasture, but a few are in woodland or brush. The severe hazard of erosion is the main management concern to the use of these soils for row crops. Low to moderate available water capacity is a limitation on some soils. Contour stripcropping and methods of tillage that leave large amounts of crop residue on the surface help reduce erosion and are well suited to these soils. Livestock farms, common in areas of this association, provide manure which is returned to the soil and helps reduce erosion and increase intake of air and water. Grassed waterways help reduce the forming of gullies, which form easily in drainageways not protected with grass cover.

Moderately Steep to Very Steep Soils Formed Mostly in Loess, Bedrock Residuum, and Colluvium on Uplands

These soils formed mostly in wind-deposited silty material, sandstone residuum, and flaggy colluvium from limestone. They formed under mixed hardwood forest and grass prairie. Most areas of these soils are used for woodland, pasture, and forage crops. The main management concerns are the steepness of slope and the hazard of erosion. These soils make up about 2 percent of the survey area.

6. Seaton-Norden-Brodale Association

Moderately steep to very steep, well drained, silty and loamy soils; on narrow ridges and foot slopes

This association consists of narrow ridges and long foot slopes below very steep side slopes of ridges. The ridges are convex, and the foot slopes are concave. Narrow drainageways and gullies dissect the foot slopes and ridges. Slopes are typically 12 to 45 percent but range to 70 percent in some areas.

This association makes up about 2 percent of the county (fig. 7). It is about 30 percent Seaton soils, 28 percent Norden soils, and 21 percent Brodale soils. The rest is soils of minor extent.

Seaton soils are on the concave foot slopes below very steep side slopes of high ridges. These soils are moderately steep and very steep. The surface layer is dark grayish brown silt loam. The subsoil is dark yellowish brown and brown silt loam. The underlying material is light olive brown silt loam.

Norden soils are on the summits and sides of low narrow ridges extending from the very steep ridges upslope. These soils are moderately steep and very steep. The surface layer is dark grayish brown silt loam. The upper part of the subsoil is dark yellowish brown and olive brown loam, and the lower part is olive brown loam. The underlying material is platy, olive sandstone.

Brodale soils are on the sides of ridges and are very steep. The surface layer is very dark gray cobbly fine sandy loam. The subsurface layer is very dark grayish brown very cobbly loam. The underlying material is dark brown, olive brown, and light olive brown very cobbly loam.

Of minor extent are the excessively drained Boone soils, the somewhat excessively drained Eleva soils, and the well drained La Farge soils on the low ridges associated mostly with Norden soils. The well drained Dorerton and Lamoille soils are on the moderately steep upper sides of the ridges above Brodale soils. The well drained Nodine and Rollingstone soils are on narrow ridgetops at the higher elevations. The well drained Lacrescent soils are on the wooded north- and east-facing slopes on the very steep side slopes of ridges. The well drained Council and Elbaville soils and the somewhat excessively drained Plainfield Variant soils are on foot slopes. The well drained and moderately well drained Chaseburg soils are in narrow drainageways that dissect the ridge.

Most areas of this association are used for woodland, pasture, or forage crops. The very steep Brodale soils on the grassy sides of ridges are left idle. Woodland consists mainly of stands of oak and hickory. Production is low on the steep to very steep ridge side slopes because the available water capacity is low. Trees grow well on the foot slopes because the available water capacity is high. The very steep slopes restrict the use of logging equipment. Erosion is a severe hazard along logging roads and skid trails.

The narrow ridgetops and the lower parts of the foot slopes are used for pasture or forage crops. Most areas of pasture are bluegrass, and some contain brush and weeds. On the ridgetops pasture is limited during summer because of limited available water capacity. The foot slopes are productive if well managed.

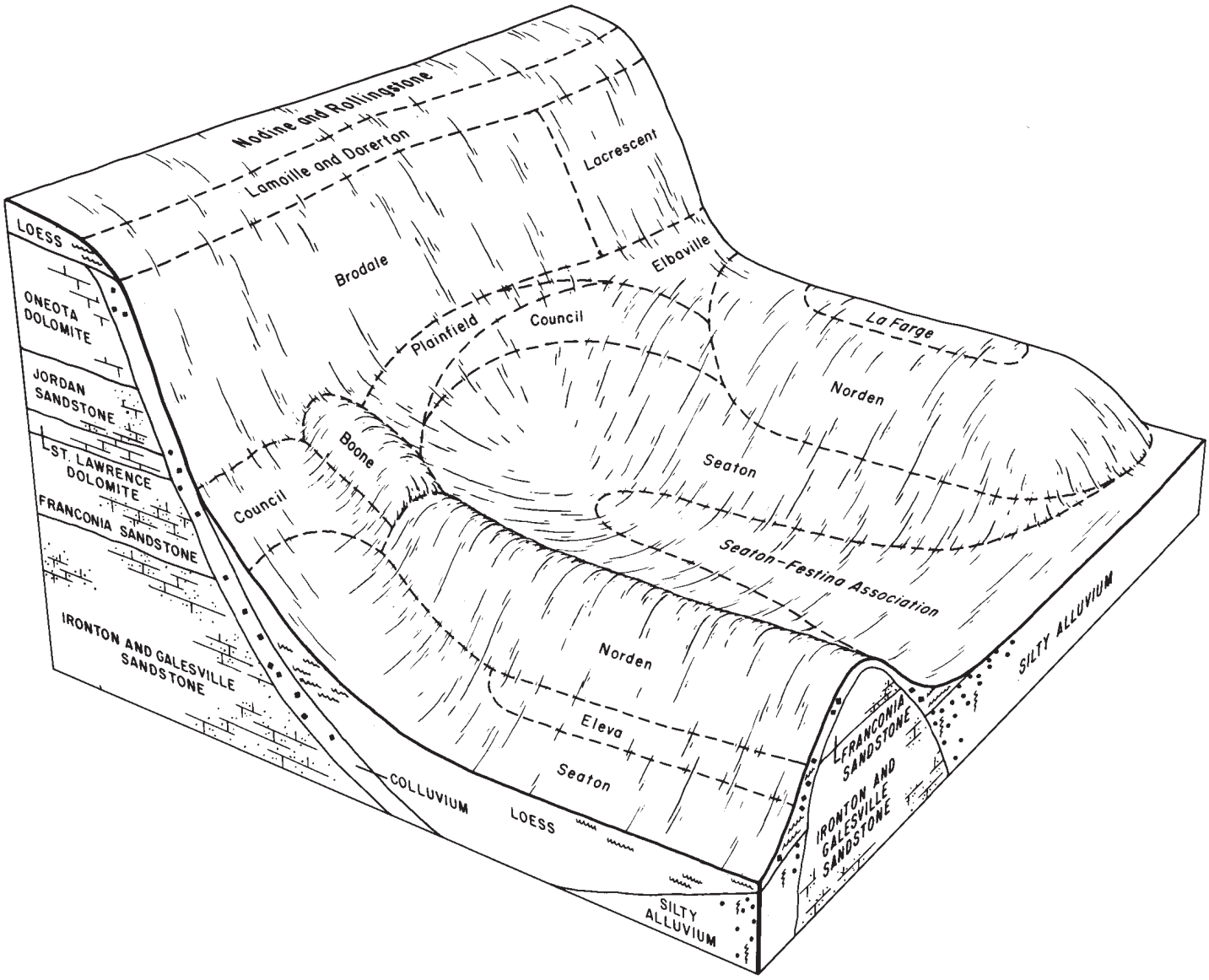

Figure 7.—Pattern of soils and underlying material in the Seaton-Norden-Brodale Association.

Nearly Level to Very Steep Soils Formed Mostly in Loess and Alluvium on Flood Plains and the Adjacent Foot Slopes and Terraces

These well drained to very poorly drained soils formed in loess or silty alluvium. They formed under deciduous forest and tall grass prairie. Most areas of these soils are used for cropland and pasture. Where management is good, many of these soils are suited to intensive cultivation. The hazards of erosion and flooding are the main management concerns. The wetter or steeper soils are suited to pasture and woodland. The three associations in this group make up about 11 percent of the survey area.

7. Arenzville-Seaton-Festina Association

Nearly level to very steep, well drained and moderately well drained, silty soils; on foot slopes, terraces, and flood plains

This association consists of flood plains, narrow terraces, and the lower foot slopes below the very steep side slopes of ridges. The terraces are 25 to 80 feet in elevation above the flood plain. They are mainly nearly level and have short, steep to very steep side slopes. Narrow drainageways dissect the terraces. The foot

slopes are upslope from the terraces. Slopes are generally less than 6 percent but range to as much as 70 percent on the terrace side slopes.

This association makes up about 3 percent of the county (fig. 8). It is about 27 percent Arenzville soils, 17 percent Seaton soils, and 15 percent Festina soils. The rest is soils of minor extent.

Arenzville soils are nearly level and are on the flood plains. They are commonly flooded in spring for very brief periods. The surface layer is dark grayish brown silt loam. The underlying material is stratified, brown and very dark grayish brown silt loam that has thin strata of very fine sandy loam and loamy very fine sand. Next is a buried soil that is black and very dark gray loam. Below that is dark brown loam stratified with thin layers of dark grayish brown and brown sandy loam, fine sandy loam, and very fine sandy loam.

Seaton soils are sloping to very sloping and are on the foot slopes. The surface layer is dark grayish brown silt loam. The subsoil is dark yellowish brown and brown silt loam. The underlying material is light olive brown silt loam.

Festina soils are mainly nearly level to sloping and are on the terraces. The surface layer is very dark grayish brown silt loam. The subsoil is dark yellowish brown and olive brown silt loam. The underlying material is olive brown silt loam.

Of minor extent, on the flood plains, are the moderately well drained to somewhat excessively drained Beavercreek soils, the well drained Huntsville soils, and the moderately well drained and well drained Chaseburg soils. Also on flood plains are the moderately well drained Kennebec and Rawles soils, the poorly drained Colo and Comfrey soils, and the poorly drained and very poorly drained Newalbin soils. The well drained and moderately well drained Timula soils and the

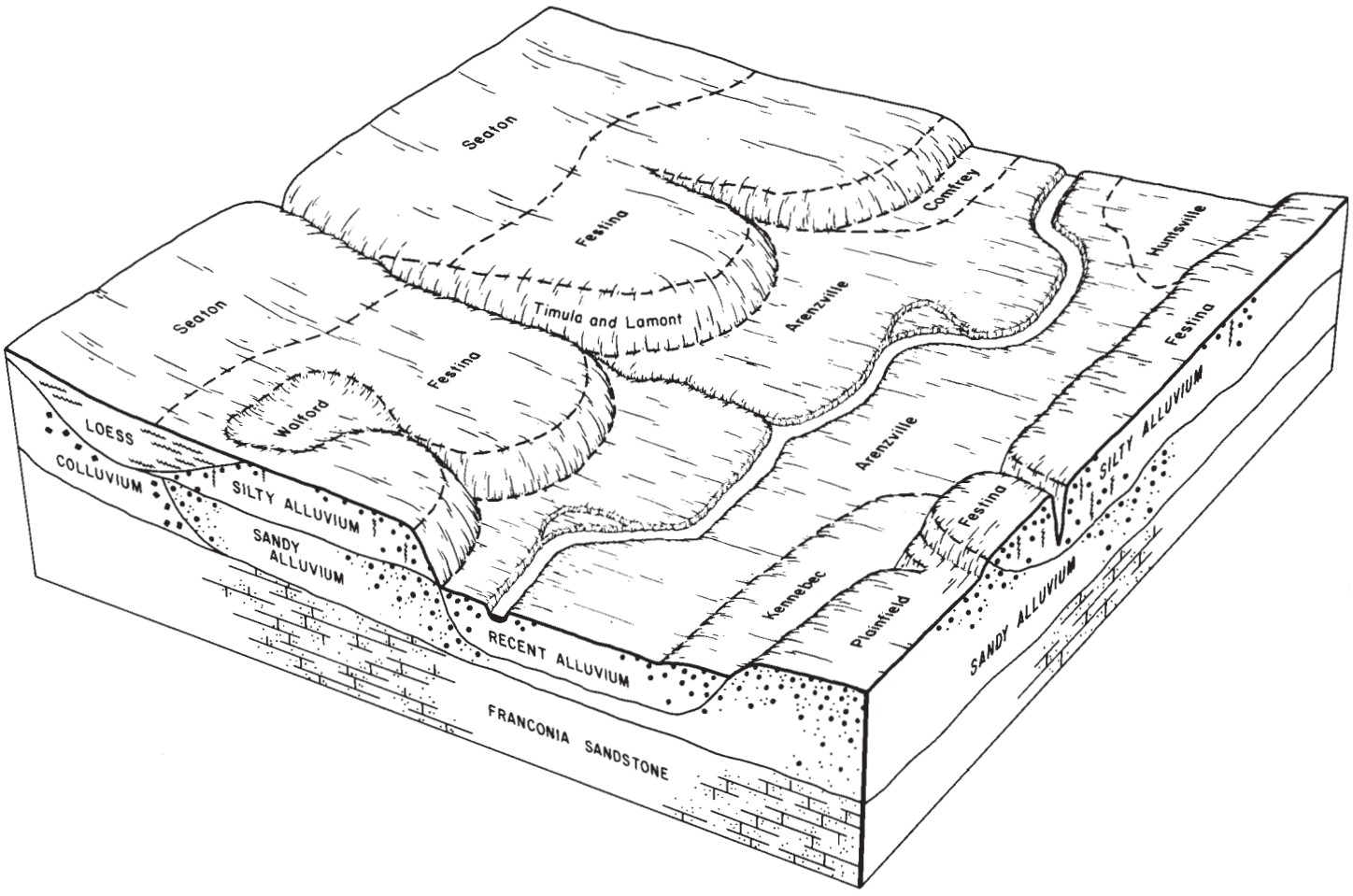

Figure 8.—Pattern of soils and underlying material in the Arenzville-Seaton-Festina Association.

excessively drained Plainfield soils are on terrace side slopes. The well drained Bertrand soils, the somewhat excessively drained Billet soils, the somewhat poorly drained Littleton soils, and the poorly drained Walford soils are on the terraces. The well drained Elbaville soils and the somewhat excessively drained Plainfield soils are on the foot slopes.

Most areas of this association have been cleared and are used for cropland. The soils that are too steep or too wet for cropland are commonly used for pasture. A small acreage of this association is in brush or woodland. Most of the well drained to somewhat poorly drained soils are very productive. Corn is the major crop, and in many places it is grown continuously. Flooding is the main limitation to row crops on the flood plains, but floods mostly occur early in the growing season and do not delay planting.

Some areas of the poorly drained soils are cropped, but in most years yields are low unless the soils are drained. Tile works well if outlets are available.

The poorly drained soils on the flood plains, the soils on the terrace side slopes, and the steeper soils on foot slopes are used for pasture. Bluegrass is the dominant pasture species. It grows well on the poorly drained soils because moisture is available during summer. The terrace side slopes are poor for pasture because of rapid to very rapid runoff. Overgrazing and grazing when the soils are wet are management concerns on the foot slopes and, especially, on the terrace side slopes. Overgrazing causes gullies to form and sediment to be carried to nearby streams.

8. Seaton-Festina Association

Nearly level to very steep, well drained and moderately well drained, silty soils; on foot slopes and terraces

This association consists of foot slopes and terraces. Narrow flood plains, 10 to 75 feet lower in elevation than the terraces, dissect the terraces into many areas irregular in shape. Side slopes of the terraces are short and moderately steep to very steep. Slopes are dominantly 0 to 12 percent but range to as much as 70 percent on the terrace side slopes.

This association makes up about 3 percent of the county. It is about 42 percent Seaton soils and 23 percent Festina soils. The rest is soils of minor extent.

Seaton soils are on the lower part of foot slopes below the side slopes of ridges. These soils are sloping to very steep. The surface layer is dark grayish brown silt loam. The subsoil is brown and dark yellowish brown silt loam. The underlying material is light olive brown silt loam.

Festina soils are on the terraces. These soils are nearly level to sloping. The surface layer is very dark grayish brown silt loam. The subsoil is dark yellowish brown and olive brown silt loam. The underlying material is olive brown silt loam.

Of minor extent are the well drained and moderately well drained Chasburg soils and the poorly drained and very poorly drained Newalbin soils on flood plains. The excessively drained Plainfield soils, the well drained and moderately well drained Timula soils, the somewhat poorly drained Littleton soils, and the poorly drained Walford soils are on terraces. The well drained and moderately well drained Council soils are on foot slopes, and the well drained Lacrescent soils are on the very steep side slopes of ridges.

Most areas of this association have been cleared and are used for cropland. The soils on the foot slopes are very productive, but practices are needed to control erosion because of easily erodible soils on long slopes. Contour stripcropping and tillage methods that leave large amounts of crop residue on the surface are well suited to these soils. Narrow drainageways crossing these soils develop gullies easily unless the drainageways are maintained as grassed waterways.

The soils on the terraces are very productive if properly managed. Most of the terrace soils are used to grow corn continuously. Maintenance of a friable surface, porous to air and water, is an important management concern. Some of the soils need drainage to be productive. Tile drains work well in these soils.

The steep to very steep terrace side slopes, irregular-shaped areas on the terraces, and the narrow flood plains are not suitable for cropland. They have poor to good suitability for pasture. Pasture management in most places generally is limited to controlling grazing of the existing bluegrass. Overgrazing is a concern on the steep to very steep terrace side slopes because gullies develop easily and are difficult to stabilize. In places structures are needed to stabilize gullies and control bank erosion along streams.

9. Seaton-Newalbin-Arenzville Association

Nearly level to very steep, well drained to very poorly drained, silty soils; on flood plains and adjacent foot slopes

This association consists of foot slopes and flood plains along streams in the eastern part of the county. Meandering creeks dissect the flood plains. They are fed by main drainageways that dissect the nearby ridges. The flood plains in most places are subject to occasional flooding. Most flooding occurs in spring during snowmelt, but occasionally flooding occurs later in the growing season. Slope is typically 1 to 30 percent but ranges to 70 percent on the sides of terraces.

This association makes up about 5 percent of the county. It is about 31 percent Seaton soils, 21 percent Newalbin soils, and 12 percent Arenzville soils. The rest is soils of minor extent.

Seaton soils are on foot slopes below side slopes of nearby ridges. These soils are sloping to very steep. The surface layer is dark grayish brown silt loam. The subsoil

is brown and dark yellowish brown silt loam. The underlying material is light olive brown silt loam.

Newalbin soils are poorly drained and very poorly drained and are on flood plains. These soils are nearly level. The surface layer is very dark grayish brown silt loam. The underlying material is dark gray silt loam with very thin strata of grayish brown and light brownish gray very fine sand. Below this material is a buried soil. It is black fine sandy loam.

Arenzville soils are on flood plains and are nearly level. They are mainly on the upper reaches of streams. In places they are on the lower reaches of streams in narrow strips along the channel. The surface layer is dark grayish brown silt loam. Underlying this is stratified, brown and very dark grayish brown silt loam that has thin strata of very fine sandy loam and loamy very fine sand. Next is a buried soil that is black loam in the upper part and very dark gray loam in the lower part. Below this is dark brown, stratified loam.

Of minor extent on the flood plains are the moderately well drained to somewhat excessively drained Beavercreek soils, the well drained Huntsville soils, and the poorly drained Comfrey soils. Also on flood plains are the poorly drained to very poorly drained Root soils and the very poorly drained Palms soils. Of minor extent on the terraces are the well drained Timula soils, the well drained and moderately well drained Festina soils, the excessively drained Plainfield soils, and the poorly drained Zwingle soils. The well drained to moderately well drained Council soils and the well drained Elbaville soils are on foot slopes. The well drained Lacrescent soils are on the very steep side slopes of ridges.

Most areas of this association are used for beef cattle production and dairying. Soils on the foot slopes are productive, but steepness of slope and easily erodible soils are limitations to row crops. Most of the soils are suited to forage crops. Corn is grown on the lower part of foot slopes, but practices are needed to control erosion. Stripcropping and tillage methods that leave large amounts of crop residue on the surface are well suited. Heavy applications of manure are commonly needed to help reduce erosion and increase the intake of air and water.

The soils on the lower reaches of streams are generally too wet for cropland, unless drained. A few areas have been drained with tile. These drained soils, along with the nearly level well drained and moderately well drained soils on the flood plains and terraces, are used for production of corn. They are well suited to this use. In places the soils on flood plains are subject to occasional flooding. Areas along Crooked Creek are protected by large dams.

The undrained wet soils and soils on the terraces and foot slopes are used for pasture. Productivity of the existing bluegrass ranges from good on the wet soils to poor on the steep to very steep terrace side slopes. Overgrazing and grazing when the soils are too wet are major management concerns on the steep to very steep soils. If the protective plant cover deteriorates, gullies form easily. Some areas are too steep, too wet, or too inaccessible to equipment for planting, fertilizing, and clipping. Management is, therefore, limited to grazing.

Most of the terrace side slopes, the steep parts of foot slopes, and the narrow upper reaches of the stream are wooded. Oaks are dominant on the terrace side slopes and the foot slopes. Elm, cottonwood, aspen, and oak are dominant on the flood plains. The soils on the foot slopes and narrow flood plains are more productive than soils in the other positions. Some of the soils are well suited to black walnut. Productivity on the terrace side slopes is low because the very rapid runoff results in insufficient moisture.

Level to Very Steep Soils Formed Mostly in Alluvium on Flood Plains, Terraces, and the Associated Side Slopes

These very poorly drained to excessively drained soils formed in silty and loamy alluvium on flood plains and in sandy alluvium on terraces and the adjacent side slopes. The soils on the flood plains formed dominantly under tall prairie grasses and mixed hardwoods. The soils in narrow drainageways and in depressions formed under reeds and sedges. The soils on the terraces formed mainly under mixed hardwoods. Most areas of these soils are used for cropland, pasture, wildlife habitat, and homesites. The main management concerns are the hazards of flooding and erosion and the limitation of droughtiness on the terrace soils. The three associations in this group make up about 13 percent of the survey area.

10. Plainfield-Rawles-Minneiska Association

Level to very steep, excessively drained, sandy soils; on terraces; and moderately well drained, calcareous, silty and loamy soils; on flood plains

This association consists of terraces and flood plains along the Root River. Creeks have dissected the terraces and flood plains into irregular-shaped tracts. Terraces are commonly 60 to 80 feet in elevation above the flood plains and have steep to very steep side slopes. Slope is mostly less than 2 percent but ranges to 70 on the terrace side slopes.

This association makes up about 5 percent of the county. It is about 15 percent Plainfield soils, 13 percent Rawles soils, and 8 percent Minneiska soils. The rest is soils of minor extent.

Plainfield soils typically are on terraces but in a few places are on foot slopes. The terraces are nearly level to moderately steep, and the foot slopes are steep and very steep. The surface layer is very dark grayish brown sand. The subsoil is dark yellowish brown sand. The underlying material is yellowish brown sand.

Rawles soils are on flood plains and are nearly level. The surface layer is calcareous, very dark gray silt loam. Underlying this is stratified, calcareous, very dark grayish brown, black, brown, and very dark gray silt loam. Next is a buried soil that is calcareous, very dark gray silty clay loam. Below this is stratified, black and very dark gray silt loam.

Minneiska soils are on flood plains and are nearly level. The surface layer is calcareous, very dark brown fine sandy loam. Next is stratified, calcareous, very dark brown and very dark grayish brown loam, loamy fine sand, and fine sandy loam. Below this is stratified, dominantly grayish brown sand.

Of minor extent on the flood plains are the excessively drained Sparta soils, the well drained and excessively drained Gotham soils, and the well drained Terril soils. Also on flood plains are the well drained and moderately well drained Abscota, Abscota Variant, Becker, Chaseburg, and Minneiska Variant soils, the moderately well drained Kennebec soils, the poorly drained Comfrey and Colo soils, and the poorly drained and very poorly drained Moundprairie soils. On terraces are the well drained Bertrand, Billett, Lindstrom, Richwood, and Timula soils and the well drained and moderately well drained Festina soils. On foot slopes are the somewhat excessively drained Plainfield Variant, the well drained Elbaville and Eyota soils, and the well drained and moderately well drained Council and Seaton soils. On the sides of upland ridges are the excessively drained Boone and Brodale soils and the well drained Lacrescent soils.

Most of the soils in this association are farmed or used for pasture. The soils on the flood plains are mainly used to grow corn. The hazard of occasional flooding is the main limitation. Wetness and low to moderate available water capacity are limitations on some of the soils. The soils on the terraces are used mostly for corn, soybeans, forage crops, and small grain. Low to moderate available water capacity is the main limitation. The lower parts of the foot slopes are used to grow corn and forage crops. Steepness of slope and easily erodible soils are the main limitations. Contour stripcropping and tillage methods that leave large amounts of crop residue on the surface are well suited to these soils. Gullies develop rapidly in these easily erodible soils unless drainageways crossing foot slopes are maintained as grassed waterways.

Areas that are irregular in shape, terrace side slopes, and foot slopes too steep to farm but suitable for grazing are used for pasture. Overgrazing is a major concern on the side slopes and foot slopes because gullies form easily in areas of insufficient plant cover. Pasturing the terrace side slopes is not practical because the loose sandy substratum erodes easily. In many places, the terrace side slopes are severely gullied.

The sandy soils on the terraces and the steep soils on the foot slopes are used for woodland in places. The foot slopes are well suited to trees, especially oaks native to the survey area. Because of low available water capacity, the sandy terraces are better suited to drought-tolerant species, such as pine, than to some other species.

The excessively drained to well drained soils that are underlain by sand are well suited to use as homesites if central sewer systems are provided. The sandy substratum is too permeable in many places to adequately filter sewage effluent.

11. Moundprairie Association

Level, poorly drained and very poorly drained, silty soils; on flood plains

This association consists mainly of flood plains. Foot slopes and small irregular-shaped terraces dissected by narrow stream valleys are included. The terraces are 70 to 80 feet in elevation above the flood plain.

This association makes up about 2 percent of the county. It is about 45 percent Moundprairie soils. The rest is soils of minor extent.

Moundprairie soils are on flood plains. The surface layer is calcareous, very dark gray silty clay loam. Next is very dark gray silt loam. Below this is a buried soil that is black silty clay loam in the upper part and very dark gray silty clay loam in the lower part.

Of minor extent on the flood plains are the well drained and moderately well drained Abscota, Abscota Variant, Arenzville, and Rawles soils, the poorly drained Kalmarville soils, and the very poorly drained Boots soils. On the terraces are the excessively drained Plainfield, Sparta, and Lilah soils, the somewhat excessively drained Dickinson soils, and the well drained Lamont soils. The well drained and moderately well drained Seaton soils are on the foot slopes.

Most areas of this association are used for cropland and pasture or are idle and support a growth of brush. Mainly, the soils on terraces are used for cropland, those on terrace side slopes are in brush, and those on foot slopes are used for forage crops and pasture.

Wetness and flooding are the main limitations to growing crops on the flood plains. Some of the poorly drained soils are used for cropland, but wetness hampers tillage operations and limits production. The soils are difficult to drain because of lack of suitable outlets. The well drained and moderately well drained soils in this association are productive, but fields typically are small.

Many areas in this association are used for pasture. The poorly drained soils, mainly on the flood plains, are well suited to bluegrass pasture, but production can be increased by planting or seeding to more water-tolerant grasses. The very poorly drained soils that support a growth of reeds and sedges are poorly suited to pasture.

The excessively drained to well drained soils on the terraces have sandy or gravelly sand underlying material.

They are well suited to use as sites for buildings. Much of the town of La Crescent is on these soils.

12. Comfrey-Shiloh Association

Nearly level, poorly drained and very poorly drained, silty and clayey soils; on flood plains

This association consists of flood plains, backwater areas along the Mississippi River, and small areas of terraces and foot slopes. Areas of this association are subject to occasional flooding, generally early in the growing season.

This association makes up about 6 percent of the county. It is about 25 percent Comfrey soils, 8 percent Shiloh soils, and 58 percent water areas. The rest is soils of minor extent.

Comfrey soils are on low ridges a few feet above water or above soils in depressions. The surface layer is very dark gray silty clay loam. The subsurface layer is very dark gray clay loam and loam. The underlying material is dark gray loam and fine sandy loam.

Shiloh soils are in depressions. They are ponded most of the growing season. The surface layer is very dark gray silty clay. The next layer is black silty clay loam. The underlying material is very dark gray silty clay.

Of minor extent are the moderately well drained and well drained Abscota soils and the poorly drained Kalmarville soils. Abscota soils are sandy and along major channels. Kalmarville soils are at the mouth of streams where they enter the flood plain of the Mississippi River.

A large part of the areas is open water. Nearly all of the rest is in woodland or marshland. A few areas are used for pasture. Most of the soils are too wet or too inacessible to use for cropland or pasture. Vegetation in the marshes consists of reeds, rushes, and sedges of various species. In many years, the areas of marshland are ponded year round. They provide food and cover for birds, waterfowl, furbearers, and fish. Vegetation on the low ridges above the marshes is mainly cottonwood, silver maple, willow, yellow birch, black ash, red maple, elm, and other bottom land species. A major part of this association is owned and managed by the United States Fish and Wildlife Service.

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Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Seaton silt loam, 6 to 12 percent slopes, is one of several phases in the Seaton series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Beavercreek-Arenzville complex, 1 to 12 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

8A—Sparta loamy sand, 0 to 6 percent slopes. This excessively drained, nearly level to gently undulating soil is on terraces along the Root River. Slopes are convex to concave. Areas are irregular in shape and range from 3 to about 20 acres.

Typically, the surface layer is very dark brown loamy sand about 20 inches thick. The subsoil is dark brown and dark yellowish brown loamy sand about 18 inches thick. The underlying material is yellowish brown and brown sand to a depth of about 60 inches. Small areas that have convex slopes have a dark grayish brown surface layer. In small shallow depressions the surface layer is 24 to 36 inches thick. In places the surface layer and subsoil contain more fine sand. Thin strata of sandy loam or clay loam 1 to 4 inches thick are between depths of 30 and 60 inches in many places.

Water and air move through this soil at a rapid rate. The available water capacity is low. Surface runoff is slow. Availability of phosphorus and potassium in the subsoil is low. The subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons. This soil warms and dries very early in the season. It is very easy to till and can be tilled soon after rains.

Most areas of this soil are used for pasture or woodland. A few areas are used for cropland. This soil is poorly suited to row crops, such as corn and soybeans, because of the low available water capacity. These crops suffer severely from drought except in occasional years when rainfall is very timely. Blowing sand is a severe hazard to row crops in places. This can be

controlled by growing row crops in alternating strips with hay crops or by using methods of seedbed preparation that leave a large amount of crop residue on the surface all season long. Applications of manure further reduce soil blowing and increase soil fertility. Small grain is better suited to this soil than row crops because small grain can better utilize the available moisture early in the growing season. This soil is suited to irrigation; however, frequent applications are necessary because of the low available water capacity. Large amounts of nutrients are needed to correct the very low fertility.

This soil is poorly suited to forage crops and pasture because of the low available water capacity. Forage and pasture crops, however, take better advantage of the early and late season moisture supply than row crops. Drought-tolerant varieties, proper fertilization and liming, and harvesting at the proper stage in growth improve yield and quality of forage. Legumes in particular need lime and potassium to maintain stands. The production of forage and pasture is generally low on this soil. Because of the low available water capacity, plants, forage crops, and pasture respond better to small applications of nutrients, rather than large, at intervals throughout the season. Allowing pasture plants to reach the proper height for grazing increases pasture production. Controlling weeds and clipping mature plants also increase production. Pasture can be used efficiently and maintained in good condition by using proper stocking rates and rotating pasture.

This soil has fair suitability for trees. Trees, such as pine, are better suited than some other species because they take better advantage of the limited moisture supply. Seedling mortality is a severe hazard. In new plantations, weed competition needs to be controlled. This can be done by spraying with approved herbicides or by cultivation.

This soil is suitable for building sites and for local roads. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible lessens the severity of this hazard, but additional precautionary measures are necessary in some areas.

This soil is in capability subclass IVs.

11C—Sogn silt loam, 2 to 12 percent slopes. This somewhat excessively drained, gently sloping and sloping soil is on the crests of narrow ridges and mesalike hills. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark grayish brown very flaggy loam about 6 inches thick. The underlying material is highly fractured limestone bedrock. In the northern and eastern parts of the county, the bedrock is hard and massive. In places the silty layer is more than 20 inches thick. Small areas have a thin clayey subsoil 2 to 5 inches thick.

Included with this soil in mapping are small areas of well drained Frankville, Lacrescent, and Rollingstone soils. The Frankville and Rollingstone soils have mostly plane and concave slopes. The Frankville soils have a thicker silty mantle than this Sogn soil and make up 1 to 2 percent of mapped areas. The Rollingstone soils have a clayey subsoil and make up 1 to 5 percent. The Lacrescent soils have a cobbly loam subsoil. They are deeper to bedrock and are on positions similar to those of the Sogn soil. They make up about 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very low. Surface runoff is medium. The availability of phosphorus and potassium in the subsoil is medium. The soil is neutral or slightly acid throughout. The content of organic matter in the surface layer is moderate. The rooting zone is limited to a depth of 8 to 20 inches. The water table is below a depth of 6 feet in all seasons. This soil warms and dries early in the season.

Most areas of this soil are used for forage crops, pasture, or pastured woodland. The soil is poorly suited to row crops, such as corn, because of the very low available water capacity. It has fair to poor suitability for forage crops and pasture. Forage crops and pasture are better suited to this soil than row crops because they take advantage of the available moisture in the early and late parts of the growing season and in the cooler temperatures at these times. Native warm-season grasses, such as little bluestem and sideoats grama, are in some areas. These species can be encouraged to increase if livestock is removed after grazing early in spring. Controlling summer grazing increases the percentage of warm-season plants in the pasture. Pasture is difficult to renovate because of the bedrock at a shallow depth.

This soil has poor suitability for woodland. Trees consist mostly of sparse stands of birch, eastern redcedar, and white oak. Suitable trees are limited to species that can tolerate the very low moisture supply, such as eastern redcedar and pine.

This soil is poorly suited to use as building sites because of the underlying bedrock. In most areas the bedrock is very hard or cemented, and large machinery is required for bedrock excavations. The underlying bedrock also hinders road construction. This soil is poorly suited to use as septic tank absorption fields because of the depth to bedrock. In places the bedrock hinders the installing of distribution lines.

This soil is in capability subclass VIIs.

16—Arenzville silt loam. This nearly level, moderately well drained soil is in valleys along streams that drain into the Root and Mississippi Rivers. This soil is subject to occasional flooding, mainly early in spring. Most areas are dissected by narrow channels. Areas tend to be elongated and range from 5 to about 100 acres.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. Next is about 22 inches of stratified, brown and very dark grayish brown silt loam and thin strata of very fine sandy loam and loamy very fine sand. The underlying material is a buried soil. The upper part is black and very dark gray loam about 24 inches thick. The lower part to a depth of about 60 inches is dark brown loam and many thin strata of dark brown and brown sandy loam, fine sandy loam, and very fine sandy loam. In places small amounts of cobbles and pebbles are on and in the soil. Some areas have a thick, very dark brown surface layer and a dark yellowish brown loam or silt loam subsoil. Small areas are somewhat poorly drained.

Included with this soil in mapping are small areas of well drained to moderately well drained Beavercreek soils and poorly drained Newalbin soils. The Beavercreek soils are shallow to cobbly material and are adjacent to streams or on alluvial fans. The Newalbin soils are on the lower landscape positions. Each of these soils make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. Surface runoff is slow. The available water capacity is very high. The availability of potassium is high and phosphorus is medium in the subsoil. The solum is neutral or mildly alkaline. The organic matter content in the surface layer is moderately low to moderate. The seasonal high water table is at a depth of 3 to 6 feet. The rooting zone extends to a depth of 60 inches or more. The soil is easy to till but tends to puddle during rains and forms a crust upon drying. It can be tilled through a wide range of soil moisture.

Most areas of this soil are used for cropland. Corn, alfalfa-grass forage, and small grain are the commonly grown crops. Corn and soybeans are well suited and can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. Flooding is the main limitation to growing crops. Floods generally occur early in spring during snowmelt, but in some years flooding occurs later in the growing season. The frequency of flooding is variable; some areas are rarely flooded. Along Crooked Creek this soil is protected by large upstream dams. Applications of manure and returning large amounts of crop residue to the soil reduce crusting, improve fertility, and increase intake of moisture.

This soil is well suited to forage crops and pasture. The selection of suitable plant varieties is important for high yields. Forage crops respond well to the proper amount and kind of fertilizer. Lime is not needed on this soil. Harvesting at the proper stage in crop growth increases forage quality and palatability. Most pasture is bluegrass, which is unproductive during the warm summer. Introducing legumes improves pasture productivity. A proper supply of nutrients, proper stocking rates, and rotating pasture provide more forage and maintain the sod in good condition. Allowing pasture plants to reach the proper height before grazing and clipping mature plants also increase pasture growth. Root damage occurs in legumes in areas where water collects just before the soil freezes in fall. Fences can be difficult to maintain in areas that are flooded.

A few areas of this soil are in woodland. Trees grow well on this soil. Removal of undesirable species improves the growth of preferred trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, well compacted fill material and providing adequate side ditches and culverts help protect the roads from flood and frost damage.

This soil is in capability subclass IIw.

18—Comfrey silt loam, occasionally flooded. This nearly level, poorly drained soil is along narrow stream valleys. It is subject to occasional flooding, except where protected by large upstream dams. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is black silt loam about 8 inches thick. The subsurface layer is black silt loam and loam about 27 inches thick. The underlying material to a depth of about 60 inches is dark gray loam and has light olive brown mottles. Small areas are underlain by sandy loam, loamy sand, or sand within a depth of 40 inches. Small areas have a very dark grayish brown surface layer of recently deposited sediment as much as 30 inches thick. In places the soil is silty throughout.

Included with this soil in mapping are small areas of well drained Huntsville soils and poorly drained Root soils. The Huntsville soils are silty and are on slightly elevated positions. The Root soils are cobbly and are adjacent to stream channels. The included soils make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is high. Surface runoff is slow. The availability of phosphorus is high and potassium is medium in the underlying material. The content of organic matter in the surface layer is high. Reaction is neutral through strongly acid in the upper part of the soil and slightly acid in the lower part. The water table is at a depth of 1 to 3 feet during the wet parts of the year, unless the soil is drained. The rooting zone is restricted to a depth of 1 to 2 feet in undrained areas. This soil warms and dries slowly in spring. It is moderately easy to till.

This soil is used for cropland, pasture, and woodland. It has fair suitability for row crops, such as corn and soybeans. The major limitations to these crops are wetness and flooding. This soil receives seepage from the surrounding slopes, and undrained areas are saturated for long periods. Tillage is difficult, and planting is generally delayed because of wetness. Tile drains can be used to intercept seepage and lower the water table. This allows the soil to warm earlier in spring and to dry more quickly after rains. It also allows roots to penetrate deeper and increases the uptake of nutrients. If drainage is proper and soil management good, row crops can be grown continuously. The occasional flooding damages crops or delays planting in some years.

This soil is poorly suited to most legumes used for forage crops unless the soil is drained. Root rot is a severe hazard to alfalfa. If properly drained and managed, this soil is well suited to the commonly grown legumes and grasses. The selection of suitable varieties is important for high yields. Forage crops respond well to proper kinds and amounts of fertilizer. Lime is not generally needed on this soil. Harvesting at the proper stage of growth increases forage quality and palatability.

This soil is well suited to pastureland. Most pastureland is undrained, and plants that tolerate wetness are needed. The moisture supply is commonly high throughout the growing season. Cool-season grasses normally produce well except during extremely hot weather. Damage to the plant cover can be prevented and a friable surface maintained by grazing only when the surface soil is firm. Allowing plants to reach the proper height for grazing also increases production. A proper nutrient supply, clipping, and weed control help improve productivity. Proper stocking rates and pasture rotation utilize forage efficiently and maintain the sod in good condition.

This soil is generally not suitable for building sites because of the flooding hazard. Structure damage can result because of low soil strength. Septic tank absorption fields are generally not suitable because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding, wetness, and low soil strength.

This soil is in capability subclass IIw.

25—Becker sandy loam. This nearly level, well drained soil mainly is on the flood plain of the Root River. Small scattered areas are in narrow valleys. Slopes are slightly concave to concave. These soils are subject to rare flooding. Areas are irregular in shape and range from 4 to about 40 acres.

Typically, the surface layer is very dark brown sandy loam about 12 inches thick. The subsurface layer is very dark brown and dark brown sandy loam about 16 inches thick. The subsoil is brown loamy sand about 6 inches thick. The underlying material is brown and dark yellowish brown sand and fine sand to a depth of about 60 inches. In places the soil is loamy to a depth of more than 40 inches.

Included with this soil in mapping are small areas of moderately well drained Minneiska soils, well drained and moderately well drained Rawles soils, and a well drained soil that is sandy throughout. The Minneiska and Rawles soils are at a lower elevation and make up 2 to 5 percent of mapped areas. They do not have a thick, dark colored surface layer. The sandy soil is on positions similar to those of the Becker soil and makes up 2 to 10 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. Surface runoff is slow, and available water capacity is moderate. The availability of phosphorus is medium and potassium is low in the subsoil. The subsoil is slightly acid or neutral. The organic matter content of the surface layer is moderate or high. The seasonal high water table is below a depth of 4 feet. The rooting zone extends to a depth of 40 inches or more. This soil warms and dries early in the growing season. It dries soon after rains and is easy to till. This soil can be tilled through a wide range of soil moisture.

Most areas of this soil are used for cropland. Suitability is fair for row crops, such as corn and soybeans. These crops can be grown satisfactorily nearly every year if fertility is maintained and weeds, insects, and diseases are controlled. Because of the limited available water capacity, crops suffer from drought unless rainfall is timely throughout the growing season. Where corn and soybeans are grown, plant populations and fertilizer application rates need to be adjusted to the limited moisture supply. Crops are damaged or planting is delayed by flooding in some years, but this is rare in most places. The loamy texture, deep rooting zone, and nearly level slopes are advantageous for high value crops, such as vegetables. Irrigation is needed for high yields.

This soil has fair suitability for forage crops and pasture, and a few areas are in these uses. Plants adapted to the limited moisture supply are needed along with a proper supply of nutrients, proper stocking rates, and control of weeds. Potassium fertilizer is needed to maintain stands of legumes. Delaying grazing until plants are at the proper height and clipping mature plants improve productivity. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

This soil is not generally used for woodland but is well suited to trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is generally not suitable for use as building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised,

well compacted fill material and providing adequate side ditches and culverts help protect the roads from flooding and frost damage.

This soil is in capability subclass IIs.

27B—Dickinson sandy loam, 1 to 6 percent slopes. This well drained and somewhat excessively drained, gently sloping soil is on stream terraces. Slopes are slightly convex to slightly concave. Areas are irregular in shape and range from 3 to about 20 acres.

Typically, the surface layer is black sandy loam about 12 inches thick. The subsurface layer is very dark grayish brown sandy loam about 10 inches thick. The subsoil is about 15 inches thick. The upper part is dark yellowish brown sandy loam, and the lower part is dark yellowish brown loamy sand. The underlying material to a depth of about 60 inches is yellowish brown sand. In a few places the soil is moderately well drained. In places the underlying material is stratified sandy loam, fine sand, and loamy sand.

Included with this soil in mapping are small areas of well drained Sparta soils and a well drained soil that has a loam subsoil and is underlain by sand at a depth of less than 20 inches. The Sparta soils are sandy. The included soils are on positions similar to those of this Dickinson soil. They make up 5 to 10 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. The available water capacity is low. Surface runoff is medium. The subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low. The availability of phosphorus and potassium in the subsoil is low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season. It is easy to till and can be tilled satisfactorily through a wide range of soil moisture.

Most areas of this soil are used for cropland or pasture. Alfalfa-grass forage, small grain, and corn are commonly grown. Row crops are poorly suited. The main limitation to crops is the low available water capacity. Corn and soybeans suffer from droughtiness unless rainfall is well distributed throughout the growing season. Where corn and soybeans are grown, plant populations, plant varieties, and fertilizer rates need to be adjusted to the limited moisture supply. Small grain, early peas, and sweet corn are better suited to this soil because they take better advantage of the warming of the soil and the available moisture early in the growing season.

This soil is well suited to irrigated crops, such as vegetables. Frequent applications of water are needed because the soil can store only a small amount of water. Large amounts of fertilizer are needed to correct the low soil fertility. Blowing sand is a hazard to row crops. Tillage methods that leave large amounts of crop residue on the surface and applications of manure control erosion and improve the moisture and nutrient supply to plants.

This soil has fair suitability for forage crops and pasture. Forage crops make good use of the available moisture in the early and late parts of the growing season and in the cooler temperatures at those times. Suitable varieties are important for good production of forage and pasture. Crops respond well to lime and the proper amounts and kinds of fertilizer. Potassium is needed to maintain legume stands. Harvesting at the proper stage of growth increases forage quality and palatability. Pasture growth can be increased by allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants. Proper stocking rates and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Trees are suited to this soil, but areas are not generally used for woodland. Because of the low available water capacity, this soil is better suited to trees that tolerate drier sites, such as pine, than to other species. Competing plants can be controlled by cultivation or by spraying with herbicides.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the hazard of frost action. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible decreases the severity of this hazard.

This soil is in capability subclass IIs.

76A—Bertrand silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on terraces along the Root River. Slopes are slightly concave to slightly convex. Areas are irregular in shape and range from 5 to about 40 acres.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsoil is about 46 inches thick. The upper part is dark brown and dark yellowish brown silt loam, the middle part is yellowish brown silt loam and loam, and the lower part is yellowish brown sand grading to loamy sand. The underlying material is light yellowish brown sand to a depth of about 60 inches. In places the surface layer and subsoil are loam. Sand is at a depth of 30 to 40 inches in places. In places near the town of La Crescent, the underlying material is stratified gravelly sand and sand at a depth of 4 to 7 feet. In some areas the soil is moderately well drained.

Included with this soil in mapping are small areas of well drained Lamont soils. Lamont soils have more sand in the surface layer and subsoil. They are on positions

similar to those of this Bertrand soil and make up 2 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is high. Surface runoff is medium. The availability of phosphorus is very high and potassium is low or medium in the subsoil. The subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low to moderate. The water table is below a depth of 6 feet in all seasons. The rooting zone is 60 inches or more thick. This soil warms and dries early in the growing season. It is moderately easy to till. This soil puddles during rains, and a crust forms upon drying. The crusting reduces the intake of air and water.

Most areas of this soil are used for cropland and are well suited to corn, small grain, forage grasses, and legumes. Row crops can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. A friable surface soil can be maintained and crusting reduced by returning crop residue to the soil and keeping tillage to a minimum.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Hay and pasture crops respond well to fertilizer on this soil. Potassium is needed to maintain legume stands. Many areas of pasture are in bluegrass, and production can be improved by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize pasture production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

A few areas of this soil are in woodland. The soil is well suited to trees. Removal of undesirable species improves the growth of preferred trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

The foundations and footings of buildings constructed on this soil should be designed to prevent structural damage caused by shrinking and swelling. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Constructing roads on well compacted, coarse textured borrow material helps protect the roads from damage caused by low strength and frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability class I.

76B—Bertrand silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on side slopes on terraces along the Root River. Slopes are convex and short. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is dark yellowish brown, friable silt loam about 36 inches thick. The underlying material is yellowish brown and light yellowish brown sand to a depth of 60 inches. Part of the original surface has been eroded in places, and the plow layer contains some dark yellowish brown subsoil material. In some areas the surface layer and subsoil are loam. In places sand is above a depth of 40 inches. In some areas near the town of La Crescent, the underlying material is stratified gravelly sand and sand at a depth of 4 to 7 feet. In some areas this soil is moderately well drained.

Included with this soil in mapping are small areas of well drained Lamont soils. The Lamont soils are in positions similar to those of this Bertrand soil but have more sand in the surface layer and subsoil. The included soils make up 2 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is high. Surface runoff is medium. The availability of phosphorus is very high and potassium is low or medium in the subsoil. The subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low to moderate. The water table is below a depth of 6 feet in all seasons. The rooting zone is 60 inches or more thick. This soil warms and dries early in the growing season. It is moderately easy to till.

Most areas of this soil are farmed. Areas are small in size; therefore, they generally are managed with the dominant nearby soils. This soil is well suited to cultivated crops. It is used mainly for corn, but small grain, forage grasses, and legumes are also grown. The control of erosion and maintenance of a friable surface layer are the major management concerns. Row crops can be grown satisfactorily every year if erosion is controlled, fertility is maintained, and weeds, insects, and diseases are controlled. The short slopes are difficult to contour. Erosion can be controlled by farming across the slope wherever possible and planting occasional sod crops or applying large amounts of manure. Tillage methods that leave large amounts of crop residue on the surface reduce soil loss and crusting.

This soil is well suited to forage crops and pasture. Suitable varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Potassium is needed to maintain legume stands. Many areas of pasture are in bluegrass, and production can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

A few areas of this soil are in woodland. The soil is well suited to trees. Removal of undesirable species is favorable to the growth of preferred trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

The foundations and footings of buildings constructed on this soil should be designed to prevent structural damage caused by shrinking and swelling. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability subclass IIe.

79B—Billett sandy loam, 1 to 6 percent slopes. This well drained, nearly level to gently sloping soil is on terraces along the Root River and its tributaries. Slopes are mostly convex. Narrow shallow drains dissect this soil. Areas are irregular in shape and range from 3 to 10 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The upper 21 inches of the subsoil is dark yellowish brown and yellowish brown sandy loam, and the lower 6 inches is brownish yellow sand. The underlying material is light yellowish brown sand to a depth of about 60 inches.

Included with this soil in mapping are small areas of well drained and somewhat excessively drained Gotham soils. Also included are well drained loamy and silty soils that are underlain by sand or loamy sand at a depth of 20 to 40 inches. The Gotham soils contain more sand than this Billett soil and are on the convex parts of the slopes. They make up about 5 percent of mapped areas. The silty and loamy soils, typically, are on positions similar to those of this Billett soil and are in shallow drainageways. They make up about 2 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. Surface runoff is slow. The available water capacity is low. The availability of phosphorus and potassium in the subsoil is low. The subsoil is neutral through medium acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone is 60 inches or more thick. This soil warms and dries very early in the growing season. It is easy to till, and tillage can be performed satisfactorily through a wide range of soil moisture.

Most areas of this soil are used for cropland, pasture, and woodland. Corn, alfalfa-grass forage, and small grain are the main crops. Suitability is fair for row crops, such as corn. Low available water capacity is the main limitation to row crops. Yields of corn and soybeans are reduced by insufficient moisture unless rainfall is well distributed throughout the growing season. Corn and soybean populations and varieties and fertilizer rates need to be adjusted to the limited moisture supply. Early season crops, such as small grain, early peas, and sweet corn, are better suited to this soil than late-season crops because they take better advantage of warming of the soil and the available soil moisture.

This soil is well suited to irrigation. Frequent applications of water are needed because the soil can store only a small amount of water. Large amounts of fertilizer are needed to correct the low soil fertility. Blowing sand is a hazard to row crops. Soil blowing can be controlled by tillage methods that leave a large amount of crop residue on the surface. Returning crop residue and applying manure to the soil also reduce erosion and improve the moisture and nutrient supply.

This soil has fair suitability for forage crops and pasture. Low available water capacity is the main limitation. Hay and pasture crops are better suited to this soil than row crops. They make good use of the soil moisture in the early and late parts of the growing season and in the cooler temperatures at those times. Suitable plant varieties are important for best yields. Crops respond well to lime and the proper amounts and kinds of fertilizer. Potassium is needed to maintain legume stands. Harvesting at the proper stage of growth increases forage quality and palatability. Pasture production can be increased by allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds. Pasture can be utilized efficiently by using proper stocking rates and rotating pasture.

This soil is not generally used for woodland but has fair suitability for this use. Because of the low available water capacity, this soil is better suited to trees that tolerate drier sites, such as pine, than to other species. Plant competition can be controlled by cultivation or by spraying with herbicides.

This soil is suitable for building site development. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability subclass IIIs.

79C—Billett sandy loam, 6 to 12 percent slopes. This well drained, sloping soil is on the upper side slopes of terraces. Slopes are mostly convex and short. Areas are irregular in shape and range from about 3 to 5 acres.

Typically, the surface layer is dark brown sandy loam about 7 inches thick. The upper 17 inches of the subsoil is yellowish brown sandy loam, and the lower 5 inches is yellowish brown loamy sand. The underlying material is yellowish brown silt loam in the upper part and stratified, yellowish brown and brown loamy sand, sandy loam, and loam to a depth of about 60 inches. Strongly convex areas have lost some of the original surface soil because of erosion. In small areas the surface layer and subsoil are loam. In a few spots loose sand is at a depth of less

than 20 inches. In a few areas the underlying material contains as much as 10 percent fragments of sandstone.

Included with this soil in mapping are small areas of well drained and somewhat excessively drained Gotham soils and well drained loamy and silty soils that are underlain by sand or loamy sand at a depth of 20 to 40 inches. The Gotham soils contain more sand than this Billett soil and typically are on the more convex parts of the landscape. They make up about 1 to 5 percent of the mapped areas. The silty and loamy soils are on positions similar to those of this Billett soil. They make up 2 to 5 percent of mapped areas; however, in a few places, only the silty soil is present.

Water and air move through this soil at a moderately rapid rate. Surface runoff is medium. The available water capacity is low. The availability of phosphorus and potassium in the subsoil is low. The subsoil is neutral through medium acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season. It is easy to till. Tillage can be performed satisfactorily through a wide range of soil moisture.

Most areas of this soil are used for cropland. Because the areas are small in size, they are generally managed with the nearby soils. Alfalfa-grass forage, corn, and small grain are the main crops grown. This soil is poorly suited to row crops. The main limitations are low available water capacity and the severe hazard of erosion. Corn and soybeans suffer from drought unless rainfall is very timely through the warm, dry summer. Corn and soybean populations and varieties and fertilizer rates need to be adjusted to the limited moisture supply. Small grain, early peas, and sweet corn are better suited to this soil than some other species because they take better advantage of the warming of the soil and the available moisture early in the growing season. If row crops are grown, practices are needed to control water erosion and soil blowing. Erosion can be controlled by growing occasional hay crops or by using tillage methods that leave large amounts of crop residue on the surface. Applications of manure help reduce erosion and improve fertility.

This soil has fair suitability for forage crops and pasture. Because of the low available water capacity, forage crops are better suited to this soil than corn. Forage crops make better use of the available moisture in the early and late parts of the growing season and in the cooler temperatures at those times. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and pasture yields can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

This soil is not commonly used for woodland, but it has fair suitability for this use. Because of the low available water capacity, trees that tolerate drier sites, such as pines, are better suited than some other species. In places, spraying with herbicides or cultivation is needed to reduce plant competition.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads constructed on this soil should be placed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the hazard of frost action. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe.

81F—Boone sand, rocky, 20 to 70 percent slopes. This excessively drained, steep to very steep soil is on side slopes near the ends of narrow ridges. Slopes are convex. Areas are irregular in shape and range from 3 to about 5 acres.

Typically, the surface layer is dark grayish brown sand about 3 inches thick. The upper 31 inches of the underlying material is dark yellowish brown and yellowish brown, loose sand, and the lower part to a depth of about 60 inches is very pale brown, weakly cemented sandstone. In places the sandstone is within a depth of 20 inches or below a depth of 40 inches. A few small areas have a fine sandy loam surface layer. In small areas the surface layer and underlying material are loamy very fine sand.

Included with this soil in mapping are small areas of excessively drained Brodale soils, well drained Lacrescent soils, and outcrops of sandstone. The Brodale and Lacrescent soils are cobbly and loamy. They are upslope from the Boone soil and make up 1 to 10 percent of mapped areas. Sandstone outcrops make up 1 to 10 percent.

Water and air move through this soil at a rapid rate. Available water capacity is very low. Surface runoff is rapid. The availability of phosphorus and potassium in the subsoil is low. The soil is slightly acid throughout. The content of organic matter in the surface layer is low. The water table is below a depth of 6 feet in all seasons. In most places the rooting zone is restricted by the sandstone at a depth of less than 40 inches.

Most areas of this soil are idle. They support a sparse growth of native grasses. Some areas are used for

pasture. This soil is poorly suited to cropland, hay crops, pasture, and woodland. Limitations are severe because of the steep to very steep slopes, very low available water capacity, and moderate depth to bedrock.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are commonly needed when roads are constructed on this soil. Roads need to be placed on the contour and roadbanks planted to well adapted grasses to minimize the erosion hazard. This soil is poorly suited to septic tank absorption fields because of slope, depth to bedrock, and because the bedrock does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies. The bedrock hinders installing of distribution lines in some areas. If septic systems must be placed in this soil, distribution lines should be placed on the contour and as close to the surface as possible. Further precautionary measures are needed in some areas to completely overcome the limitations.

This soil is in capability subclass VIIs.

103A—Seaton silt loam, 1 to 3 percent slopes. This well drained, nearly level soil is on the crest of ridges. Slopes are convex or plane. Areas are irregular in shape and range from 3 to about 15 acres.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is dark yellowish brown silt loam about 48 inches thick. The underlying material to a depth of about 60 inches is pale brown, friable silt loam. The surface layer is darker and thicker in some areas.

Included with this soil in mapping are well drained Blackhammer and Southridge soils. These soils formed in a thinner mantle of loess than this Seaton soil and have a subsoil formed in erosional sediment. They make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. The availability of phosphorus is very high and potassium is low in the subsoil. The subsoil is medium acid through very strongly acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season and is moderately easy to till. The range in moisture content suitable for tillage is moderately wide. This soil puddles during rains and forms a crust upon drying. A friable surface soil is difficult to maintain.

Most areas of this soil are used for cropland, but some areas are used for pasture. Most areas are small in size and are managed with the nearby soils. Corn, forage crops, and small grain are commonly grown. Row crops are well suited and can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. Tillage methods that leave large amounts of crop residue on the surface and applications of manure reduce crusting and improve intake of air and water.

This soil is well suited to forage crops and pasture. Suitable varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass, and many of these can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Some areas are grazed and can be improved by limiting livestock grazing, which reduces natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for planting of preferred trees. Plant competition is moderate in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage or by careful spraying with herbicides.

This soil is suitable for building site development. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability class I.

103B—Seaton silt loam, 3 to 6 percent slopes. This well drained, gently sloping soil is on the crest of ridges. Slopes are convex, long, and smooth. Individual areas are irregular in shape and range from 5 to about 40 acres.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil to a depth of about 60 inches is dark yellowish brown and brown silt loam. In a few strongly convex areas, the brown subsoil is exposed as a result of erosion. In a few places the surface layer is darker and more than 10 inches thick. Some concave areas are moderately well drained. In some areas the soil is underlain by clayey, loamy, or sandy sediment within a depth of 60 inches.

Included with this soil in mapping are small areas of well drained Blackhammer and Southridge soils. These soils formed in a thinner mantle of loess than the Seaton soil and have a subsoil that formed in erosional sediment. They are on positions similar to those of the

Seaton soil. The included soils make up 5 to 10 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is very high and potassium is low. The subsoil is medium acid through very strongly acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season and is moderately easy to till. The range in moisture content suitable for tillage is moderately wide. This soil is easily eroded. The surface layer tends to puddle during rains and forms a crust upon drying. This reduces intake of air and water. The surface layer is difficult to maintain in a friable condition.

Most areas of this soil are used for cropland, but some areas are used for pasture and woodland. The commonly grown crops are alfalfa-grass forage, corn, and small grain. The soil is well suited to row crops, such as corn. The hazard of erosion is the main limitation. Row crops can be satisfactorily grown every year if erosion is controlled, fertility is maintained, and weeds, insects, and diseases are controlled. Erosion can be controlled by using tillage methods that leave a large amount of crop residue on the surface. These tillage methods are well suited to the early warming and drying of this soil. Erosion can also be controlled by growing forage crops in the rotation. Growing corn and forage crops in alternating strips on the contour and using terraces are well suited to the long, smooth slopes. Application of manure reduces soil loss and crusting and improves fertility. Shaping and seeding drainageways to grassed waterways prevent gullies from forming on this easily erodible soil.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few irregular-shaped areas are used for pasture. Pasture plants are mainly bluegrass. Pasture can be improved in many areas by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and pasture rotation utilize the forage efficiently and maintain the sod in good condition.

Trees are well suited to this soil, but only a few areas are in woodland. Some of these areas are grazed and can be improved by limiting livestock grazing, which reduces natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for planting of preferred trees. Plant competition is moderate in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage, by girdling, or by careful spraying with herbicides.

This soil is suitable for building site development. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability subclass IIe.

103C2—Seaton silt loam, 6 to 12 percent slopes, eroded. This well drained, sloping soil is on ridgetops. Slopes are mostly convex, long, and smooth. Areas are elongated and range from 4 to about 50 acres.

Typically, the surface layer is a mixture of dark grayish brown and brown silt loam about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable silt loam about 35 inches thick. The underlying material to a depth of about 60 inches is yellowish brown silt loam. Most areas in pasture and woodland have not been eroded. In some areas the soil is moderately well drained. In places clayey, loamy, or sandy sediment is within a depth of 60 inches. The most severely eroded convex areas have a brown surface layer that is lower in organic matter and less friable. A few small concave areas have a thicker surface layer.

Included with this soil in mapping are small areas of Chaseburg, Frankville, Nodine, and Rollingstone soils. The Chaseburg soils are in narrow drainageways and contain less clay. They make up 2 to 5 percent of mapped areas. The Frankville soils have very flaggy silty clay at a depth of 20 to 36 inches. The Nodine soils have a loamy subsoil within a depth of 15 inches. The Rollingstone soils have a clayey subsoil within a depth of 15 inches. The Frankville, Nodine, and Rollingstone soils are on positions similar to those of this Seaton soil and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is moderate. The availability of phosphorus is very high and potassium is low in the subsoil. The subsoil is medium acid through strongly acid. The content of organic matter in the surface layer is moderately low. The rooting zone extends to a depth of 60 inches or more in most places. The water table is below a depth of 6 feet in all seasons. This soil warms and dries early in the season and is moderately easy to till. The range in moisture content suitable for tillage is moderately wide. This soil is easily eroded. The surface layer of this soil tends to puddle during rains and forms a crust upon drying. This reduces further intake of air and water. A friable surface layer is difficult to maintain.

Most areas of this soil are used for cropland. Some areas are used for pasture and woodland. Alfalfa, grass forages, corn, and small grain are commonly grown. Suitability is fair for row crops. The main limitation is the

hazard of erosion. Corn can be grown satisfactorily nearly every year if terraces are used in combination with tillage methods that leave large amounts of crop residue on the surface. These practices are well adapted to the long, smooth slopes. Growing forage crops and corn in alternating strips on the contour is also well suited to controlling erosion on this soil. Application of manure reduces soil loss, decreases crusting, and increases fertility. Shaping and seeding drainageways to grassed waterways help to prevent gullies from forming.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer. Potassium is needed to maintain stands of legumes. A few mainly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass, and in many of these areas pasture can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture help utilize the forage efficiently and maintain the sod in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Some areas are grazed and can be improved by limiting grazing, which reduces natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for planting of preferred trees. Plant competition is moderate in new plantations. Competing vegetation, such as brush and weeds, can be controlled by girdling, by tillage, or by careful spraying with herbicides.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe.

103D2—Seaton silt loam, 12 to 20 percent slopes, eroded. This well drained, moderately steep soil is on ridgetops. Slopes are mostly convex, long, and smooth. Areas are elongated and range from 3 to about 20 acres.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is brown and yellowish brown silt loam about 48 inches thick. The underlying material to a depth of about 60 inches is yellowish brown silt loam. Most areas in pasture and woodland have not been eroded. In some areas clayey, loamy, or sandy sediment is within a depth of 60 inches. The most severely eroded convex parts of the slope have a dark brown surface layer that is lower in content of organic matter and less friable. A few small concave areas have a thicker, darker colored surface layer.

Included with this soil in mapping are small areas of Chaseburg, Frankville, Nodine, and Rollingstone soils. The Chaseburg soils are in narrow drainageways and contain less clay than this Seaton soil. They make up 1 to 5 percent of mapped areas. The Frankville soils have limestone at a depth of 20 to 40 inches. The Nodine soils have a loamy subsoil within a depth of 15 inches. The Rollingstone soils have a clayey subsoil within a depth of 15 inches. Frankville, Nodine, and Rollingstone soils are on positions similar to those of the Seaton soil and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is rapid. The availability of phosphorus is very high and potassium is low in the subsoil. The subsoil is medium acid through strongly acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches. This soil warms and dries early in the growing season and is moderately easy to till. The range of moisture suitable for tillage is moderately wide. This soil is easily eroded. The surface layer of this soil tends to puddle during rains and forms a crust upon drying. This reduces intake of air and water. A friable surface layer is difficult to maintain.

Most areas of this soil are used for cropland. Some areas are in pasture. Corn, alfalfa-grass forage, and small grain are commonly grown. Row crops are poorly suited because of the hazard of erosion. Erosion can be controlled if corn is grown in a crop rotation system consisting mostly of forage crops. Growing corn and forage crops in alternating strips on the contour is effective in helping to control erosion and is well adapted to the long, smooth slopes. Tillage methods that leave large amounts of crop residue on the surface and applications of manure reduce soil loss. These practices also improve fertility and reduce soil crusting, thus increasing the intake of air and water. Gullies develop easily in this soil. Shaping, seeding, and maintaining drainageways as grassed waterways help prevent gullies from forming.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mainly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass, and many of these can be improved by seeding to more productive species. Allowing plants to reach the proper height

before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This soil is well suited to trees, but only a few areas are used for woodland. Some areas are grazed. They can be improved by limiting grazing, which reduces natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for planting of preferred species. Plant competition is moderate in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage, by girdling, or by careful spraying with herbicides.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Roads should be constructed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IVe.

131B—Massbach silt loam, 3 to 6 percent slopes. This well drained to moderately well drained, gently sloping soil is on the crest of narrow ridges and mesalike hills. Slopes are slightly concave to slightly convex. Areas are irregular in shape and range from 3 to about 15 acres.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is dark brown silt loam about 6 inches thick. The subsoil is about 30 inches thick. The upper part is dark yellowish brown silt loam, and the lower part is grayish brown, firm silty clay that has yellowish brown mottles. The underlying material to a depth of about 60 inches is pale olive, soft shale that has a few gray and yellowish brown mottles. In a few places the surface layer is very dark brown and more than 10 inches thick. Small convex areas have lost part of the original surface soil by erosion and have a plow layer that is a dark brown mixture of surface soil and subsoil. Some small areas are somewhat poorly drained. Small areas are underlain by clay at a depth of less than 30 inches or more than 50 inches.

Included with this soil in mapping are small areas of well drained Frankville soils and soils that are poorly drained. The Frankville soils have very flaggy clay at a depth of 18 to 36 inches over limestone. They are on positions similar to those of this Massbach soil and make up 1 to 5 percent of mapped areas. The poorly drained soils have plane slopes and make up less than 1 percent of mapped areas.

Air and water move through the surface layer and upper part of the subsoil at a moderate rate and move slowly through the lower part of the subsoil and underlying material. Surface runoff is medium. The available water capacity is high. In the subsoil the availability of phosphorus is very high and potassium is low or medium. The content of organic matter in the surface layer is moderate. The surface layer and subsoil are neutral or slightly acid. The rooting zone is restricted by the clayey subsoil at a depth of 30 to 50 inches. It is restricted by the perched water table at a depth of 3 to 5 feet for short periods during wet seasons. This soil warms and dries somewhat slowly in spring. It is moderately easy to till. Because of the high content of silt, it is easily eroded and the surface layer tends to crust after rains.

Most areas of this soil are used for cropland and pasture. Corn, alfalfa, grass forages, and small grain are commonly grown. Row crops are well suited to this soil. Erosion is a moderate hazard where this soil is cropped for corn because of the steepness of slope. Also, planting is hampered in some years by the slow warming and drying of this soil. Row crops, such as corn and soybeans, can be grown satisfactorily nearly every year if erosion is controlled. This can be done by including occasional forage crops in the cropping sequence or by farming on the contour. Tillage methods that leave large amounts of crop residue on the soil help reduce erosion. However, this practice results in lower yields in some years because it causes the soil to warm slower in the growing season. Returning crop residue and application of manure help reduce erosion and improve fertility. Also, they help maintain a friable surface that is receptive to water and air. Terraces are very effective in controlling erosion. Terraces may lower yields slightly because cutting required for the terrace channel reduces the thickness of the productive silty mantle. Also, wet spots in the terrace channel may hamper farming operations unless the spots are drained with tile. A few areas have drainageways that need to be shaped, seeded, and maintained as grassed waterways.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and the quality of forage crops. Forage and pasture crops respond well to fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture consist of bluegrass. Production in these areas can be increased by planting to more productive species. Allowing plants to reach the proper height for grazing increases production. Production can be increased further by clipping mature plants and controlling weeds. This soil is soft in the spring. Grazing, therefore, needs to be deferred until the soil firms to prevent soil compaction and damage to the plant cover.

Rotating pasture and using proper stocking rates utilize forages efficiently and maintain the sod in good condition.

This soil is well suited to trees, but only a few areas are used for woodland. Proper thinning and removal of the less desirable species help maintain a good stand of trees. Plant competition in new plantings can be controlled by tillage or carefully spraying with herbicides.

Basements of buildings on this soil need to be constructed above the seasonal high water table. Tile drains around foundations help to remove excess subsurface water. Landscaping should be designed to drain surface water away from buildings. Foundations and footings need to be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse textured material helps protect foundations from structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table and because the permeability of this soil restricts it from readily absorbing effluent. In places a mound-type absorption field is suitable.

This soil is in capability subclass IIe.

131C—Massbach silt loam, 6 to 12 percent slopes. This well drained to moderately well drained, sloping soil is on narrow ridgetops on uplands. Slopes are slightly convex to slightly concave. Areas dominantly are elongated and range from 3 to about 10 acres.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface soil. The subsoil is about 37 inches thick. The upper part is dark yellowish brown, friable silt loam, and the lower part is light olive brown, friable silt loam that has grayish brown and dark yellowish brown mottles. The underlying material is olive, calcareous, firm shale to a depth of about 60 inches. Most areas of this soil in pasture and woodland have not been eroded. In places the surface layer is very dark brown and more than 10 inches thick. Small areas are somewhat poorly drained. Small areas are underlain by shale at a depth of less than 30 inches or more than 50 inches.

Included with this soil in mapping are small areas of well drained Edmund and Frankville soils and soils that are poorly drained. The Edmund and Frankville soils have a very flaggy clay subsoil. Subsoil in the Edmund soils is at a depth of less than 18 inches and in the Frankville soils is at a depth of 18 to 36 inches. These soils are on positions similar to those of the Massbach soil and make up 1 to 5 percent of mapped areas. The poorly drained soils have plane slopes and make up less than 1 percent of mapped areas.

Air and water move through this soil at a moderate rate in the surface layer and upper part of the subsoil and slowly in the lower part of the subsoil and underlying material. Surface runoff is medium. The available water capacity is high. In the subsoil the availability of phosphorus is very high and potassium is low or moderate. The content of organic matter in the surface layer is moderate. The surface layer and subsoil are neutral or slightly acid. The rooting zone is restricted by the clayey subsoil at a depth of 30 to 50 inches and by the perched seasonal water table at a depth of 3 to 5 feet during wet seasons. This soil warms and dries somewhat slowly in spring. It is moderately easy to till through a fairly wide range of soil moisture. The surface layer tends to crust after hard rains and is easily eroded.

Most areas of this soil are used for cropland. Areas are generally small and managed with the nearby dominant soils. The main crops are corn, alfalfa-grass forage, and small grain. The suitability is fair for row crops. The hazard of erosion is the main management concern. Erosion can be controlled by including forage crops in the rotation, growing forage crops and corn in alternating rows on the contour, and using tillage methods that leave large amounts of crop residue on the surface. These tillage methods may, however, slow warming and drying of the soil during wet periods in spring. Applications of manure help reduce erosion, maintain a friable surface, and improve water and air intake. Terraces are suited to this soil. Cutting that is required in the terrace channel reduces the thickness of the productive silty soil in the channel. Wet spots can occur in the terrace channel. These spots hamper farming operations unless they are properly drained with tile. A few areas have drainageways, which need to be shaped, seeded, and maintained as grassed waterways.

This soil is well suited to forage crops and pasture. Suitable varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and the quality of forage crops. Forage and pasture crops respond well to fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture consist of bluegrass and can be improved by planting to more productive species. Allowing plants to reach the proper height for grazing, clipping mature plants, and controlling weeds increase yields of pasture. This soil is soft in spring and other wet periods. Deferring grazing until the soil is firm prevents soil compaction and damage to the plant cover. Rotating pasture and using proper stocking rates help utilize forage efficiently and maintain the sod in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Proper thinning and removal of less desirable species help maintain a good stand of trees. Plant competition in new plantings can be controlled by tillage or careful spraying with herbicides.

Basements of buildings on this soil need to be constructed above the seasonal high water table. Tile drains around foundations help to remove excess subsurface water. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Structure design needs to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table and because the permeability of this soil restricts it from readily absorbing effluent. In places a mound-type absorption field is suitable.

This soil is in capability subclass IIIe.

136—Madelia silt loam. This poorly drained, nearly level soil is below foot slopes on stream terraces, typically along the upper reaches of narrow valleys. Areas are elongated and range from 3 to about 10 acres.

Typically, the surface layer is very dark brown silt loam about 11 inches thick. The subsurface layer is black and very dark grayish brown silt loam about 12 inches thick. The subsoil is about 23 inches thick. It is olive gray, mottled silt loam. The underlying material to a depth of about 60 inches is light olive gray mottled silt loam. Some areas have a surface layer as much as 36 inches thick. In small areas the subsoil and underlying material are loam. In a few small areas the subsoil is silty clay loam or silty clay.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is slow. The availability of phosphorus is high and potassium is medium in the subsoil. The subsoil is slightly acid or medium acid. The content of organic matter in the surface layer is high. The water table is at a depth of 1 to 3 feet during wet seasons. The rooting zone extends to a depth of 60 inches or more where the soil is drained. In undrained areas the rooting zone extends to the depth of the seasonal high water table. This soil warms and dries slowly in spring. It is moderately easy to till through a fairly wide range of soil moisture.

This soil is used for cropland and pasture. If drained, it is well suited to corn, soybeans, and forage crops. Soil wetness is the main limitation. Because the soil dries slowly, it is commonly worked when it is too wet and becomes compacted and cloddy as a result. Tile drainage can lower the water table and increase the rooting depth. If properly drained, this soil warms and dries earlier in the growing season, the availability of plant nutrients is increased, and the soil can be worked within the proper range of moisture. Some areas of this soil do not need drainage because nearby creeks have cut deeply into the terrace, thereby improving the natural drainage. Row crops can be grown satisfactorily in most years if drainage is proper, nutrients are sufficient, and weeds are controlled. A friable surface receptive to the movement of air and water should be maintained by working the soil within the proper moisture range and restricting tillage to what is essential to growing the crop. Returning crop residue to the soil and applying manure increase friability of the surface and improve fertility.

This soil is well suited to forage crops if drained. Suitable plant varieties and applications of the proper kinds of fertilizer increase yields. Lime is not generally needed. Potassium is needed to maintain legume stands. Harvesting at the proper stage of crop growth increases the quality of forage.

Pasture is well suited to this soil. Areas of pasture are not generally drained. Bluegrass grows well on this soil during summer because of the abundant moisture supply throughout most of this season. However, deep-rooted legumes or grasses are more productive than bluegrass. Proper fertilization and allowing plants to reach the proper height before grazing increase yields of pasture. Clipping of mature plants and controlling weeds increase the number of productive plants. Grazing in spring needs to be deferred until the soil is firm, or the soil will be compacted and plants damaged. Proper rates of stocking and pasture rotation utilize forage efficiently and maintain the sod in good condition.

This soil is poorly suited to use as building sites because of wetness. If buildings are constructed on this soil, they should be built without basements and landscaping should be designed to drain surface water away from buildings. Tile drains around foundations help remove excess subsurface water. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table. In some places a mound-type absorption field is suitable.

This soil is in capability subclass IIw.

143E2—Eleva loam, 20 to 30 percent slopes, eroded. This steep and very steep, well drained and somewhat excessively drained soil is on side slopes and summits of low narrow ridges along stream valleys. The ridges extend from the very steep sides of nearby ridges at a higher elevation. Areas are long and narrow and range from 3 to about 10 acres.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The dark yellowish brown subsoil is about 23 inches thick. The upper part is very friable sandy loam, and the lower part is very friable loamy sand. The underlying bedrock to a depth of 60 inches or more consists of light yellowish brown and yellowish brown sandstone that is soft in some parts and hard in

other parts. Strongly convex positions are underlain by sandstone at a depth of 10 to 20 inches. The subsoil is loam in a few places.

Included with this soil in mapping are small areas of well drained Boone, Norden, and Seaton soils. The Boone soils are sandy. They are on strongly convex nose positions and make up about 1 to 5 percent of mapped areas. The Norden soils have a loamy subsoil underlain by olive gray and grayish brown, platy sandstone. They are on the summits and the upper part of the side slopes and make up 5 to 10 percent of mapped areas. The Seaton soils are silty. They are on summits and concave positions and make up 2 to 5 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. The available water capacity is low. Surface runoff is rapid. The availability of phosphorus and potassium in the subsoil is low. The surface layer is slightly acid or neutral, and the subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone is limited to a depth of 20 to 40 inches by the sandstone bedrock.

This soil is used primarily for pasture and woodland. It has fair suitability for pasture. The major limitations are the hazard of erosion, the steepness of slope, and the low available water capacity. Most areas of pasture consist of bluegrass. The pasture areas are more productive when planted to deeper rooted legumes and grasses. Some areas can be improved by clearing brush and trees. Renovation of pasture is difficult on the steep and very steep slopes. The hazard of erosion is severe during the reseeding or renovation period. Erosion can be reduced by keeping large amounts of plant residue on the surface and keeping seedbeds as cloddy as possible by working the soil only enough to obtain a good seedbed. Manure applied as a mulch after seeding further reduces the risk of soil loss. In places pasture can be renovated by using equipment that plants directly into the sod. Seeding mixtures that contain a high proportion of grasses are needed to produce a dense, erosion-resistant sod. Lime and fertilizer along with weed control are needed for productive pasture. Allowing plants to reach the proper height before grazing also improves productivity. Proper stocking rates and pasture rotation utilize forage efficiently and maintain the sod in good condition.

Some areas of this soil are in woodland. The suitability is poor for trees. The major limitations are steepness of slope and low available water capacity. Conifers, such as red pine, are better suited than some other species. In places clearing of undesired stock in stands is essential to allow for restocking or replanting of preferred trees. Natural regeneration of hardwoods may be difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves surface tilth and maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff. Maintaining the tilth and mulch increases moisture for tree growth and improves natural regeneration underneath the existing forest canopy. In new plantings, competing plants need to be controlled to allow for good growth. This can be accomplished through the careful use of herbicides. Thinning at the proper times helps produce optimum growth. Care must be taken when harvesting trees to control erosion. Constructing logging roads on the contour wherever possible helps minimize the hazard of erosion.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed when constructing roads on this soil. Roads need to be placed on the contour, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. This soil is poorly suited to use as septic tank absorption fields because of the underlying bedrock and steepness of slope. Land shaping and installing the distribution lines across the slope are generally necessary for proper operation. The bedrock can hinder the installation operations in many areas.

This soil is in capability subclass VIe.

143F—Eleva sandy loam, 30 to 45 percent slopes. This well drained and somewhat excessively drained soil is on very steep side slopes of low narrow ridges along stream valleys. These ridges extend from the very steep sides of ridges at a higher elevation. Areas are long and narrow and range from 3 to about 10 acres.

Typically, the surface layer is very dark brown sandy loam about 3 inches thick. The subsurface layer is dark grayish brown and very dark grayish brown, very friable sandy loam about 9 inches thick. The subsoil is dark brown and dark yellowish brown, very friable sandy loam about 19 inches thick. It contains a few fragments of sandstone. The underlying bedrock to a depth of about 60 inches is yellowish brown, soft sandstone. In a few places sandstone is at a depth of 10 to 20 inches.

Included with this soil in mapping are small areas of well drained Boone and Seaton soils. The Boone soils are sandy. They are on the most convex parts of the slope and make up 2 to 3 percent of mapped areas. The Seaton soils are silty. They are on summits and concave positions and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. The available water capacity is low. Surface runoff is very rapid. The availability of phosphorus and potassium in the subsoil is low. The surface layer is slightly acid or neutral, and the subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low. The water table is below

a depth of 6 feet in all seasons. The rooting zone is limited to a depth of 20 to 40 inches by the sandstone bedrock.

Most areas of this soil are in woodland. Some areas are used for pasture. This soil is poorly suited to trees. The major limitations are steepness of slope and low available water capacity. Conifers, such as red pine, are better suited than some other species because of the low available water capacity. Natural regeneration of hardwoods can be difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves surface tilth and maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff. Maintaining the tilth and mulch increases moisture for tree growth and improves natural regeneration beneath the existing forest canopy. Clearing of undesired stock in stands is essential to allow for restocking and planting of preferred trees. In new plantings, competing plants need to be controlled to allow for good growth. This can be accomplished through the careful use of herbicides. Thinning at the proper time helps produce optimum growth. Care must be taken to control erosion when harvesting trees. Constructing logging roads on the contour minimizes the hazard of runoff.

Slope is the main limitation to the use of this soil for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed where roads are constructed on this soil. Roads need to be placed on the contour, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. This soil is generally not suitable for septic tank absorption fields because of slope and depth to bedrock. Soils that are better suited for this use are generally nearby.

This soil is in capability subclass VIIe.

177B—Gotham loamy sand, 2 to 10 percent slopes. This well drained and somewhat excessively drained, gently sloping to sloping soil is on terraces. Slopes are convex to concave. Areas are incised by shallow drainageways. They are irregular in shape and range from 5 to about 20 acres.

Typically, the surface layer is dark brown loamy sand about 9 inches thick. The subsurface layer is brown loamy sand about 5 inches thick. The subsoil is yellowish brown, dark brown, and dark yellowish brown loamy sand about 18 inches thick. The underlying material to a depth of about 60 inches is yellowish brown sand. In small areas the surface layer is sandy loam, and in small areas the subsoil or underlying material has strata of sandy loam 1 to 10 inches thick.

Included with this soil in mapping are small areas of well drained Billett soils. The Billett soils have a loamy mantle of overlying sand. In most places they are in shallow drains, but in some places they are on convex surfaces. The Billet soils make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a rapid rate. Surface runoff is slow. The available water capacity is low. The availability of phosphorus and potassium in the subsoil is low. The subsoil is neutral through strongly acid. The content of organic matter in the surface layer is low to moderately low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons. This soil warms early in the spring, is easy to till, and dries soon after rains. It can be tilled satisfactorily through a wide range of soil moisture.

Most areas of this soil are used for cropland and pasture. Corn, alfalfa-grass forage, and small grain are the most common crops. Row crops are poorly suited because of the low available water capacity. Corn and soybeans suffer from drought unless rainfall is timely through the warm, dry summer. Where corn and soybeans are grown, plant populations, plant varieties, and fertilizer rates need to be adjusted to the limited moisture supply. Early season crops, such as small grain, early peas, and sweet corn, are better suited to this soil than later crops because they take advantage of the warming of the soil and the available moisture early in the growing season. The early warming and deep rooting zone are favorable to irrigated vegetable crops. Applications of irrigation water must be frequent because this soil can store only a small amount of water. Large amounts of fertilizer are needed to correct the low soil fertility. Blowing sand is a hazard to row crops. Soil blowing can be controlled by using tillage methods that leave large amounts of crop residue on the surface. Maintaining crop residue on the surface and applying manure help reduce erosion and increase the moisture and nutrient supply.

This soil has fair suitability for forage and pasture crops that have a deep root system. Deep-rooted legumes and grasses are better suited to this soil than corn because they take better advantage of soil moisture in the early and late parts of the growing season and in the cooler temperatures at those times. A proper supply of nutrients and lime is needed to establish and maintain legume stands. Harvesting at the proper stage of growth increases forage quality. Allowing plants to reach the proper height before grazing increases pasture production. Clipping mature plants and controlling weeds also increase pasture yields and improve forage quality. Proper rates of stocking and rotating pasture utilize the forage efficiently and help maintain the sod in good condition.

This soil has fair suitability for trees but is not generally used for woodland. Because of the low moisture supply, it is better suited to pine than to many other species. Plant competition can be controlled by cultivation or by spraying with herbicides.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. This soil is suitable for road construction. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible decreases the severity of this hazard, but additional precautionary measures are necessary in some areas.

This soil is in capability subclass IVe.

194—Huntsville silt loam, occasionally flooded. This well drained and moderately well drained, nearly level soil is along narrow stream valleys. Slopes are mostly plane. Areas are dominantly elongated and range from 3 to about 10 acres in size.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The upper part of the subsurface layer is black silt loam, and the lower part is very dark grayish brown silt loam. The underlying material is dark brown silt loam grading to dark yellowish brown silt loam to a depth of about 60 inches. In many places the underlying material within a depth of 40 inches is cobbly loam or is sandy. A few small areas are somewhat poorly drained. In a few small areas a small amount of coarse fragments is in the soil. In many areas the surface has a mantle of dark grayish brown and very dark grayish brown silt loam or loam erosional sediment as much as 30 inches thick.

Included with this soil in mapping are small areas of well drained and moderately well drained Beavercreek soils, well drained Becker soils, and poorly drained Comfrey and Newalbin soils. The Beavercreek soils are underlain by cobbly loamy material within a depth of 20 inches. They are next to stream channels or on alluvial fans. The Becker soils have more sand than this Huntsville soil and typically are next to stream channels. The Comfrey soils are loamy throughout, and the Newalbin soils are silty throughout. Both soils are on slightly lower positions. The included soils make up 5 to 15 percent of mapped areas.

Water and air move through this soil at a moderate rate. Surface runoff is slow. The available water capacity is very high. In the subsoil the availability of phosphorus is high and potassium is low. The reaction is neutral throughout. The content of organic matter in the surface layer is high. The water table is below a depth of 6 feet. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season, and the surface soil is friable and easy to maintain. The range in content of soil moisture suitable for tillage is moderately wide.

Most areas of this soil are used for cropland. Some areas are used for pasture. Row crops, forage crops, and small grain are well suited. Most cultivated areas are used for corn and soybeans. Row crops can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. Yields are high if management is good, particularly in areas that are protected from flooding by large upstream dams. Returning crop residue to the soil, working the soil within the proper moisture range for tillage, and keeping tillage to a minimum help maintain a friable surface layer.

This soil is well suited to forage crops and pasture. Legumes grow well if protected from flooding. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mainly irregular-shaped areas are used for pasture. Most areas of pasture are in bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action.

This soil is in capability class I.

216B—Lamont fine sandy loam, 1 to 6 percent slopes. This well drained, gently sloping soil is on stream terraces. Slopes are convex to plane. Narrow shallow drainageways cross this soil in places. Areas are irregular in shape and range from 5 to about 30 acres.

Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is brown and yellowish brown fine sandy loam about 44 inches thick. The underlying material to a depth of about 60 inches is pale brown fine sandy loam. In some areas the surface layer is silt loam. In places sand or gravelly sand is within a depth of 40 inches. Convex surfaces in some areas have a loamy fine sand surface layer. A few strongly convex spots have been eroded and have a dark brown or brown surface layer. Within and near the town of La Crescent, this soil is underlain by gravelly sand at a depth of 4 to 8 feet.

Included with this soil in mapping are small areas of well drained Bertrand soils. The Bertrand soils are silty. They are on positions similar to those of this Lamont soil and make up about 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. Surface runoff is medium. The available water capacity is moderate. In the subsoil the availability of phosphorus is medium and potassium is low. The subsoil

and underlying material are medium acid or strongly acid. The organic matter content of the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms early in the growing season and dries soon after rains. It is easy to till and can be tilled through a wide range of soil moisture.

Most areas of this soil are used for cropland, pasture, or building sites. Corn, alfalfa-grass forage, and small grain are the main crops grown. This soil has fair suitability for row crops. Corn and soybeans can be grown satisfactorily every year on this soil if fertility is maintained and weeds, insects, and diseases are controlled. The main limitation is the moderate available water capacity. Crops suffer from drought unless rainfall is well distributed throughout the growing season. Crop varieties, fertilizer rates, and plant populations, therefore, need to be adjusted to the moisture supply. Small grain and other early season crops are better suited because they can take better advantage of the available moisture early in the season. This soil is well suited to truck crops, but irrigation is needed for good yields in most years.

This soil is well suited to forage crops and pasture. Forage crops make good use of the available moisture and the cooler temperature in the early and late parts of the growing season. Suitable varieties are important. Crops respond well to lime and the proper amounts and kinds of fertilizer. Potassium is needed to maintain legume stands. Harvesting at the proper stage of growth increases forage quality and palatability. Proper rates of stocking, allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Rotating the pasture utilizes forage efficiently and maintains the sod in good condition.

The suitability is fair for trees, but this soil is not generally used for woodland. The moderate available water capacity is the main limitation for woodland. Plant competition is severe in new plantings. Young seedlings can be protected from competing plants by cultivation or by spraying with herbicides. There are no important limitations for harvesting trees.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the hazard of frost action. This soil is suitable for use as septic tank absorption fields (fig. 9).

This soil is in capability subclass IIIe.

244B—Lilah sandy loam, 2 to 6 percent slopes. This excessively drained, gently sloping soil is on stream terraces. Slopes are concave to convex. Most areas of this soil are near and within the town of La Crescent. Areas are irregular in shape and range from 5 to about 40 acres.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part is dark yellowish brown and dark brown sandy loam, and the lower part is dark brown gravelly loamy sand and sand. The underlying material to a depth of about 60 inches is stratified, dark brown and dark yellowish brown, loose sand and gravelly sand. In shallow depressions and in drainageways crossing this soil, the surface layer and subsoil are loam. In many places the soil is nearly level.

Included with this soil in mapping are small areas of a well drained sandy soil underlain by stratified gravelly sand and sand within a depth of 24 inches. This soil typically is on the most convex positions and makes up about 1 to 5 percent of mapped areas.

Water and air move through this soil at a very rapid rate. The available water capacity is low. Surface runoff is slow. The availability of phosphorus and potassium in the subsoil is low. The subsoil is slightly acid through strongly acid, and the underlying material is medium acid or slightly acid. The content of organic matter in the surface layer is low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season. It is easy to till. Tillage can be performed satisfactorily through a wide range of soil moisture.

Most areas of this soil are being used for urban development. Some areas are used for cropland.

This soil is poorly suited to row crops, such as corn and soybeans. The main limitation is the low available water capacity. Where corn and soybeans are grown, plant populations, plant varieties, and fertilizer rates need to be adjusted to the limited moisture supply. Small grain, early peas, and sweet corn are suited to this soil because they take advantage of the warming of the soil and the available moisture in the early part of the growing season. The early warming and the deep rooting zone are favorable to irrigated vegetables. This soil needs to be irrigated frequently because it can store only a small amount of water. Large amounts of fertilizer are needed to correct the low soil fertility. Blowing sand is a hazard to row crops. Tillage methods that leave large amounts of crop residue on the surface and applications of manure to the soil help control erosion and increase the moisture and nutrient supply.

This soil is well suited to forage crops and pasture. Forage crops make good use of available moisture in the

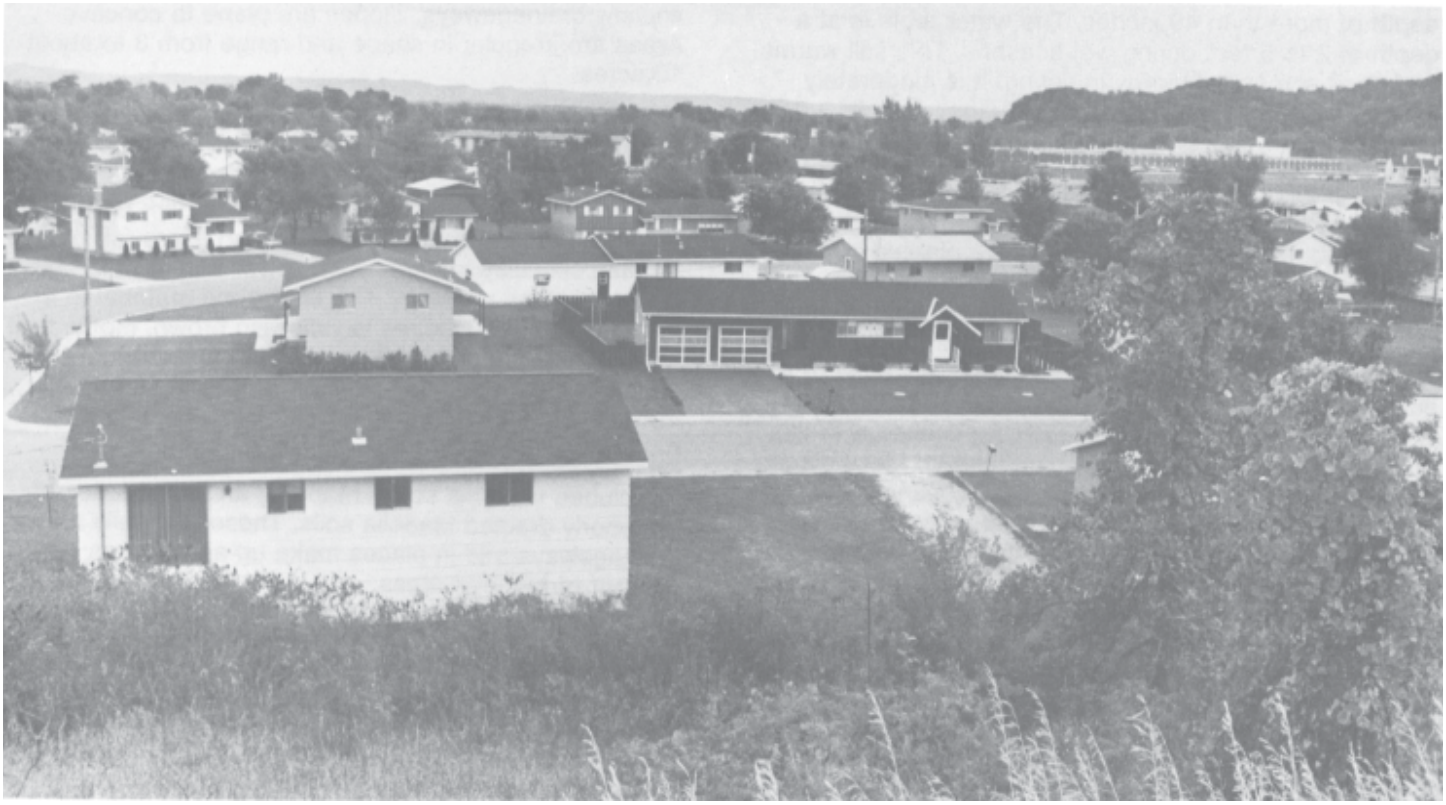

Figure 9.—Urban development in an area of Lamont fine sandy loam, 1 to 6 percent slopes. This well drained soil is suitable for use as building sites. Areas of Lilah soils are also in this landscape.

early and late parts of the growing season and in the cooler temperatures at these times. Suitable plant varieties are important. Crops respond well to lime and the proper amounts and kinds of fertilizer. Potassium is needed to maintain legume stands. Harvesting at the proper stage of growth increases forage quality and palatability. Controlling weeds and clipping mature plants also help production. Proper stocking rates and the rotation of pasture utilize forages efficiently and help maintain the sod in good condition.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. This soil is suitable for road construction. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible decreases the severity of this hazard.

This soil is in capability subclass IVs.

250—Kennebec silt loam, occasionally flooded. This moderately well drained, level soil is along stream valleys. Narrow drainageways and small depressions, in places, give the surface a slight microrelief. This soil is subject to occasional, brief flooding. Areas are irregular in shape and range from 5 to about 40 acres.

Typically, the surface layer is very dark grayish brown, calcarous silt loam about 8 inches thick. The subsurface layer is black silt loam about 40 inches thick. The underlying material is dark grayish brown silt loam to a depth of about 60 inches. Some areas of this soil are somewhat poorly drained. A few places are well drained.

Included with this soil in mapping are small areas of poorly drained Colo and Moundprairie soils and moderately well drained Rawles soils. The Colo and Moundprairie soils are in shallow drainageways and slight depressions and make up 2 to 5 percent of mapped areas. The Rawles soils are at a slightly lower elevation and make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. Surface runoff is slow. The available water capacity is very high. In the subsoil the availability of phosphorus is high and potassium is medium. The solum is neutral or mildly alkaline. The content of organic matter in the surface layer is high. The rooting zone extends to a

depth of more than 40 inches. The water table is at a depth of 2 to 5 feet during wet seasons. This soil warms and dries somewhat slowly in spring. It is moderately easy to till within a moderately wide range of soil moisture.

Most areas of this soil are used for cropland. Some areas are used for pasture and woodland. Row crops are well suited. Most areas of cropland are planted to corn and soybeans. These crops can be grown satisfactorily every year if fertility and good tilth are maintained and weeds, insects, and diseases are controlled. Planting is delayed until late in spring in some years because of the slow drying nature of this soil and because of flooding. Wetness in the poorly drained soils associated with this soil also prevents timely field operations. In many places the wet soils can be drained with tile. Working the soil within the proper range of soil moisture, keeping tillage to a minimum, and returning large amounts of crop residue to the soil help keep the soil friable and reduce compaction.

This soil is well suited to pasture because of the very high available water capacity and nearness to ground water. Grass forage crops are well suited if protected from flooding. Legume stands may be difficult to maintain because of wetness and flooding. Spring grazing should be delayed until the soil is firm and forage plants are at the proper height. Bluegrass pasture is generally productive through much of the warm summer because of the high moisture supply. Restricted grazing during wet periods, control of weeds, clipping mature plants, and a proper supply of nutrients help keep pasture productive. Proper stocking rates and pasture rotation utilize forage efficiently and maintain the sod in good condition.

A few areas of this soil are in trees. Existing woodlands can be improved by elimination of livestock grazing and removal of undesirable species and planting to more suitable species. This soil is well suited to black walnut, white ash, and sugar maple. Tree seedlings survive and grow well if competing vegetation is controlled and removed. This can be done by controlled spraying with herbicides or by tillage methods.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding, low soil strength, and frost action.

This soil is in capability subclass IIw.

273—Muscatine silt loam. This somewhat poorly drained, nearly level soil is near the heads of broad, shallow drainageways. Slopes are plane to concave. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silt loam about 6 inches thick. The subsoil is about 41 inches thick. The upper part is dark brown, mottled silty clay loam, the middle part is grayish brown, mottled silty clay loam, and the lower part is yellowish brown, mottled silt loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled silt loam. In small areas the surface layer is dark and as much as 30 inches thick. In some areas the surface layer is less than 10 inches thick. A few spots are moderately well drained.

Included with this soil in mapping are small areas of the poorly drained Madelia soils. These silty soils are in drainageways and in places make up as much as 10 percent of mapped areas.

Water and air move through this soil at a moderate rate. Surface runoff is slow. The available water capacity is very high. The content of organic matter in the surface layer is high. In the subsoil the availability of phosphorus is high and potassium is low or medium. The subsoil is medium acid through very strongly acid. The seasonal high water table ranges from 2 to 5 feet in depth. This soil warms somewhat slowly in spring. It is moderately easy to till.

Most areas of this soil are used for cropland. Corn is the main crop, but alfalfa-grass forage, small grain, and soybeans are also grown. Areas are small, and the soil commonly is managed with the adjacent soils. Row crops are well suited and can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. The surface can be maintained in a friable condition by using minimum tillage methods, such as chisel plowing, and by returning large amounts of crop residue to the soil. The soil is suited to either fall or spring plowing, chisel plowing, or other primary tillage. In places grassed waterways are needed to prevent erosion where water concentrates.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth help increase the yield and quality for forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mainly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass. Pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants help maximize the yields of forage. Proper stocking rates and rotation of

pasture utilize the forage efficiently and maintain the sod in good condition.

The basements of buildings on this soil need to be constructed above the seasonal high water table. Tile drains around foundations help to remove excess subsurface water. Landscaping should be designed to drain surface water away from buildings. Foundations and footings need to be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse textured material helps protect the foundations from structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table. In places a mound-type absorption field is suitable.

This soil is in capability class I.

283B—Plainfield sand, 0 to 6 percent slopes. This excessively drained, nearly level to gently sloping soil is on terraces. Slopes are slightly concave to slightly convex. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is grayish brown sand about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, loose sand about 25 inches thick. The upper part of the underlying material is yellowish brown, loose sand, and the lower part is pale brown, loose sand to a depth of about 60 inches. In a few areas the surface layer is more than 10 inches thick. Thin, dark yellowish brown strata of loamy sand are below a depth of 48 inches in some areas.

Included with this soil in mapping are small areas of well drained Billett soils and excessively drained Boone soils. The Billett soils have a loamy mantle and make up about 1 to 3 percent of mapped areas. The Boone soils are underlain by yellowish brown sandstone at a depth of less than 40 inches and make up less than 1 percent of mapped areas. The included soils are on positions similar to those of this Plainfield soil.

Water and air move through this soil at a rapid rate. The available water capacity is low. Surface runoff is slow. The availability of phosphorus and potassium in the subsoil is low. The subsoil is slightly acid through very strongly acid. The content of organic matter in the surface layer is low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons. This soil warms very early in the growing season and is very easy to till. It can be tilled soon after rains.

Most areas of this soil are used for cropland, pasture, and woodland. This soil is poorly suited to row crops. The low available water capacity is the main limitation. Corn and soybeans suffer severely from drought unless rainfall is very timely through the warm, dry summer. Where corn and soybeans are grown, plant populations, plant varieties, and fertilizer rates need to be adjusted to the limited moisture supply. Small grain, early peas, and sweet corn are suited to this soil because they take advantage of the warming of the soil and the available moisture early in the growing season. This soil is well suited to irrigation. Irrigation water must be applied frequently, however, because the soil can store only a small amount of water. Large amounts of fertilizer are needed to correct the low soil fertility. Blowing sand is a hazard to row crops. Soil blowing can be controlled by using tillage methods that leave large amounts of crop residue on the surface. Returning crop residue and applying manure help reduce erosion and increase the supply of moisture and nutrients.

This soil is poorly suited to forage crops and pasture because of the low available water capacity. It is better suited to forage crops and pasture, however, than to corn and soybeans. Forage crops and pasture can take advantage of the available moisture in the early and late parts of the growing season. Drought-tolerant varieties, proper fertilization and liming, and harvesting at the proper stage in growth improve yield and quality of forage. Legumes in particular need lime and potash to maintain healthy stands. Forage and pasture production is generally low on this soil. Forage crops and pasture respond best to small applications of nutrients applied at intervals throughout the season. Allowing pasture plants to reach the proper height for grazing, controlling weeds, and clipping mature plants maximize production. Forages can be used efficiently and sod maintained in good condition by using proper rates of stocking and by rotating pasture.

Trees are poorly suited to this soil; however, a few small areas are in woodland. Because of the low available water capacity, drought-tolerant species, such as pine, are better suited than many other species. Plant competition can be controlled by cultivation or by careful spraying with herbicides.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. This soil is suitable for road construction. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible decreases the severity of this hazard, but additional precautionary measures are necessary in some areas.

This soil is in capability subclass IVs.

283C—Plainfield sand, 6 to 12 percent slopes. This excessively drained, sloping soil is on the upper side slopes of terraces, on foot slopes, and on ridgetops. Slopes are convex to concave. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is very dark grayish brown sand about 4 inches thick. The subsoil is dark yellowish brown and brown sand about 24 inches thick. The underlying material is yellowish brown sand to a depth of about 60 inches. In places the surface soil is brown. In a few areas the surface layer is more than 10 inches thick. In places the underlying material contains thin layers of dark yellowish brown loamy sand.

Included with this soil in mapping are small areas of well drained Billett soils and excessively drained Boone soils. Also included are areas of excessively drained sandy soils underlain by loamy or clayey material within a depth of 60 inches. The Billett soils have a loamy mantle. The Boone soils are underlain by yellowish brown sandstone within a depth of 40 inches. The Billett and Boone soils are on positions similar to those of this Plainfield soil and make up about 2 to 5 percent of the mapped areas. The sandy soils are on narrow ridgetops and are the dominant included soils in these positions.

Water and air move through this soil at a rapid rate. The available water capacity is low, and surface runoff is medium. The availability of phosphorus and potassium in the subsoil is low. The subsoil is slightly acid through very strongly acid. The content of organic matter in the surface layer is low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons. This soil warms very early in the growing season and is very easy to till. It can be tilled soon after rains.

Most areas of this soil are used for cropland or pasture. A few areas are in woodland. Forage crops are most commonly grown. A small amount of corn is grown. Row crops, such as corn, are poorly suited because of the low available water capacity. Forage crops and pasture are better suited to this soil than row crops because forage crops can better utilize the available moisture and cooler temperatures in the early and late parts of the growing season. Drought-tolerant varieties, proper fertilization and liming, and harvesting at the proper stage in growth improve the yield and quality of forage. Legumes in particular need lime and potassium fertilizer to maintain stands. Forage and pasture production is generally low on this soil. Because of the low available water capacity, forage crops and pasture respond best to small applications of nutrients applied at intervals throughout the season. Allowing pasture plants to reach the proper height before grazing, clipping mature plants, and controlling weeds increase pasture production. Forages can be utilized efficiently and sod maintained in good condition by using proper stocking rates and rotating pasture.

Some areas of this soil are in woodland. Vegetation mainly is bur oak and black oak and brush. Trees are poorly suited. Drought-tolerant species, such as conifers, are better suited than most other species. New plantations require the removal of brush and undesirable trees in places. Seedling loss is a management concern on this soil.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads constructed on this soil should be placed on the contour, where possible, and roadbanks need to be planted to well adapted grasses to minimize the erosion hazard. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible decreases the severity of this hazard, but additional precautionary measures are necessary in some areas.

This soil is in capability subclass VIs.

283D—Plainfield sand, 12 to 25 percent slopes. This excessively drained, moderately steep to steep soil is on foot slopes below the sides of ridges along stream valleys. Slopes are plane to slightly concave or convex. Narrow drains and a few gullies cross this soil in places. Areas are irregular in shape and range from 5 to about 20 acres.

Typically, the surface layer is very dark grayish brown sand about 3 inches thick. The subsoil is dark yellowish brown, loose sand about 20 inches thick. The underlying material to a depth of 60 inches is yellowish brown and light yellowish brown, loose sand. In places the original surface layer has been partially eroded or completely eroded. In a few places on west-facing slopes, the surface layer is more than 10 inches thick. In some areas the underlying material has thin, dark yellowish brown sand or loamy sand layers below a depth of 48 inches.

Included with this soil in mapping are small areas of Billett soils. Also included are small areas of well drained sandy soils underlain by olive gray and grayish brown, platy sandstone within a depth of 60 inches and excessively drained sandy soils underlain by loamy or clayey material within a depth of 60 inches. The Billett soils have a loamy mantle and are on the more concave positions. They make up 1 to 2 percent of mapped areas. The well drained sandy soils underlain by sandstone are on positions similar to those of this Plainfield soil. They make up 1 to 2 percent of mapped areas. The sandy soils underlain by loamy or clayey material are the dominant included soils on ridgetops.

Water and air move through this soil at a rapid rate. The available water capacity is low. Surface runoff is medium. The availability of phosphorus and potassium in the subsoil is low. The subsoil is slightly acid through

very strongly acid. The content of organic matter in the surface layer is low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons.

Areas of this soil are used mainly for pasture and woodland. They are generally not suitable for row crops because of the low available water capacity and steepness of slope. They are poorly suited to forage crops and pasture because of the low available water capacity. Production of forage crops and pasture is low during dry periods. Drought-tolerant varieties, proper fertilization and liming, and harvesting at the proper stage in growth improve yield and quality of forage. Legumes in particular need lime and potash to maintain stands. Forage crops and pasture on this soil respond well to small applications of nutrients applied at intervals throughout the season. Allowing pasture plants to reach the proper height for grazing maximizes yields. Clipping mature plants and controlling weeds also increase production. Forages can be used efficiently and sod maintained in good condition by using proper stocking rates and rotating pasture. Gullies develop easily in this soil and are difficult to stabilize. Close control of grazing helps maintain the grass cover and reduces the hazard of gully formation.

Some areas of this soil are in woodland. Vegetation is made up mostly of bur oak and black oak. This soil is poorly suited to woodland because of the low available water capacity. Most woodland areas can be improved by eliminating grazing and removing undesirable trees. Drought-tolerant species, such as pine, are better suited than hardwoods. Removing trees and brush protects young seedlings and helps reduce plant competition. This can be done by prescribed burning, spraying, cutting, or girdling. Seedling mortality is a severe hazard.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads constructed on this soil need to be placed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible decreases the severity of this hazard, but additional precautionary measures are necessary in some areas.

This soil is in capability subclass VIIs.

283F—Plainfield sand, 25 to 50 percent slopes. This excessively drained, very steep soil is on valley foot slopes and side slopes of terraces. Many areas contain narrow gullies. Areas are irregular in shape and range from 10 to about 25 acres.

Typically, the surface layer is dark grayish brown sand about 6 inches thick. The subsoil is brown, loose sand about 19 inches thick. The underlying material is pale brown, loose sand to a depth of about 60 inches. In places the surface layer is very dark grayish brown. In some areas the underlying material has thin, brown layers of loamy sand. In some areas in the town of La Crescent, the surface layer is gravelly loamy sand and the underlying material is gravelly sand.

Included with this soil in mapping are small areas of well drained Billett soils, well drained Timula soils, and well drained to somewhat poorly drained sandy and loamy soils. The Billett soils have a loamy mantle. They are on positions similar to those of this Plainfield soil and make up 1 to 5 percent of mapped areas. The Timula soils are silty throughout. They are on similar positions and make up 2 to 5 percent of mapped areas. The sandy and loamy soils are in drainageways and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a rapid rate. The available water capacity is low. Surface runoff is medium. The availability of phosphorus and potassium in the subsoil is low. The subsoil is slightly acid through very strongly acid. The content of organic matter in the surface layer is low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons.

Most areas of this soil are used for pasture or woodland. They are not suitable for cropland because of steepness of slope. Slopes are too steep for renovating equipment, and production is low because of the low available water capacity. Grazing needs to be carefully controlled to maintain the plant cover. Gullies develop easily and are difficult to stabilize. In places gullies have been stabilized by planting to conifers.

This soil is better suited to woodland and wildlife habitat than to most other uses. Some areas are in oak and hickory forest types, but growth rates are slow. Because of the low available water capacity, pine is better suited to this soil than the native hardwoods. The very steep slopes prevent planting with mechanical equipment in most places. Seedling mortality is high. Competing vegetation in new plantings needs to be controlled or removed. This can be accomplished by prescribed burning, spraying with herbicides, and removal of the less desirable trees by cutting or girdling.

Slope is the main limitation for use of this soil as building sites. Extensive land shaping is generally needed. Buildings and lots should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed when constructing roads on this soil. Roads need to be placed on the contour, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. This soil is poorly suited to septic tank absorption fields because of the steepness of slope and because the soil does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the

surface as possible and placing them across the slope help decrease the severity of the slope limitation and pollution hazard, but additional precautionary measures are necessary in some areas.

This soil is in capability subclass VIIs.

285A—Port Byron silt loam, 1 to 3 percent slopes. This well drained and moderately well drained, nearly level soil is on the crests of ridges and at the heads of shallow drainageways near the crests. Slopes are convex on the crests and concave at the heads of drainageways. Areas are irregular in shape and range from 5 to about 60 acres.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silt loam about 4 inches thick. The subsoil is dark brown and dark yellowish brown silt loam in the upper part and light olive brown silt loam in the lower part to a depth of 60 inches. In places the subsoil is underlain by clayey, loamy, or sandy sediment within a depth of 40 inches.

Included with this soil in mapping are a few small sinkholes. They make up less than 1 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is medium. The subsoil is neutral through medium acid. The content of organic matter in the surface layer is high. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches. This soil warms and dries early in the growing season and is moderately easy to till. The surface soil is easy to keep in a friable condition because of the high organic matter content.

Most areas of this soil are used for cropland. Corn is the most common crop. Forage, small grain, and soybeans are also grown. This soil is well suited to row crops, such as corn. Many areas are small and managed with nearby soils. This soil has no important limitations for cultivated crops. Row crops can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. This soil is well suited to tillage methods that leave large amounts of residue on the soil surface.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and pasture yields can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

This soil is suitable for building site development. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability class I.

285B—Port Byron silt loam, 3 to 6 percent slopes. This well drained and moderately well drained, gently sloping soil is on the crest of ridges. Slopes mainly are convex but at the heads of drainageways are concave. Slopes are long and smooth. Areas are irregular in shape and range from 5 to about 120 acres.

Typically, the surface layer is black silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silt loam about 4 inches thick. The subsoil is silt loam and extends to a depth of about 60 inches. The upper part is dark brown, dark yellowish brown, and yellowish brown. The lower part is light olive brown. In places the surface layer is less than 10 inches thick or more than 24 inches. In some places the underlying material is clayey, loamy, or sandy sediment within a depth of 40 inches.

Included with this soil in mapping are small areas of well drained, stratified Eitzen soils in shallow drainageways. The included soils make up 2 to 5 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is medium. The subsoil is neutral through medium acid. The content of organic matter in the surface layer is high. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches. This soil warms and dries early in the growing season and is moderately easy to till. The surface soil is easy to maintain in a friable condition because of the high organic matter content.

Most areas of this soil are used for cropland. Corn is the main crop, but forage, small grain, and soybeans are also grown. This soil is well suited to row crops, such as corn. The main limitation is the hazard of erosion. Row crops can be grown satisfactorily every year if erosion is controlled, fertility maintained, and weeds, insects, and diseases controlled. Erosion can be controlled where corn is grown by farming on the contour and using tillage methods that leave large amounts of crop residue on the surface. These tillage methods along with applications of manure help maintain a friable surface receptive to the movement of air and water. Erosion can also be controlled by growing forage crops in rotation on the contour. Drainageways that are shaped, seeded, and

maintained as grassed waterways reduce the hazard of gully erosion.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yields and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability subclass IIe.

285C—Port Byron silt loam, 6 to 12 percent slopes. This well drained and moderately well drained, sloping soil is on ridgetops. In places it is on foot slopes below the sides of ridges. Slopes are long and smooth. They are convex on the ridgetops and concave on the foot slopes. Areas are elongated and range from 3 to about 10 acres.

Typically, the surface layer is black silt loam about 13 inches thick. The subsurface layer is very dark brown silt loam about 5 inches thick. The subsoil is about 37 inches thick. The upper part is brown and dark yellowish brown silt loam, and the lower part is yellowish brown silt loam. The underlying material to a depth of about 60 inches is yellowish brown silt loam. On some strongly convex slopes, the surface layer is less than 10 inches thick. In a few areas of concave slopes, the dark surface layer is more than 24 inches thick. Within a depth of 40 inches in places, the underlying material is clayey, loamy, or sandy sediments.

Included with this soil in mapping are small areas of well drained Eitzen soils. The Eitzen soils are stratified and in narrow drainageways. They make up 2 to 5 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is medium. The subsoil is neutral through medium acid. The content of organic matter in the surface layer is high. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches in most places. This soil warms and dries early in the growing season and is moderately easy to till. The surface is easy to maintain in a friable condition because of the high content of organic matter.

Most areas of this soil are used for cropland. Corn, alfalfa-grass forage, and small grain are commonly grown. Suitability is fair for row crops, such as corn. The hazard of erosion is the main limitation. Corn can be grown satisfactorily every year by using a combination of terraces and tillage methods that leave most of the crop residue on the surface. These tillage methods are well adapted to the long, smooth slopes and the early warming of this soil. Growing forage crops and corn in alternating strips on the contour helps control erosion and is management that is well suited to this soil. Returning crop residue to the soil, applying manure, and keeping tillage to a minimum improve fertility, reduce erosion, and increase the intake of air and water.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass. Pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forages efficiently and maintain the sod in good condition.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe.

298—Richwood silt loam. This well drained, nearly level soil is on terraces along the Root River. Slopes are slightly convex to slightly concave. Areas are irregular in shape and range from 5 to about 15 acres.

Typically, the surface layer is black silt loam about 11 inches thick. The subsurface layer is very dark grayish brown and dark brown silt loam about 3 inches thick. The subsoil is about 31 inches thick. The upper part is dark yellowish brown and yellowish brown silt loam, and the lower part is dark yellowish brown sandy loam. The underlying material to a depth of about 60 inches is yellowish brown sand with thin layers of loamy sand. In

places the sandy underlying material is at a depth as shallow as 20 inches. In a few areas the surface layer is less than 10 inches thick. In places the soil is moderately well drained.

Included with this soil in mapping are small areas of well drained Dickinson soils. The Dickinson soils formed in a sandy loam mantle and are underlain by sand at a depth of less than 40 inches. They typically are on convex surfaces and make up about 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is high. Surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is medium. The surface layer and subsoil are neutral through medium acid. The content of organic matter in the surface layer is high. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season and is moderately easy to till. The range in moisture content suitable for tillage is moderately wide.

Most areas of this soil are used for cropland. Corn is the most common crop, but forage, small grain, and soybeans are also grown. This soil is well suited to row crops, such as corn. Corn can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. A friable surface soil can be maintained by returning crop residue to the soil and keeping tillage to a minimum.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

The foundations and footings of buildings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability class I.

301B—Lindstrom silt loam, 1 to 6 percent slopes. This well drained, gently sloping and nearly level soil is in broad drainageways. Slopes are slightly concave or nearly plane. Areas are irregular in shape and range from 3 to about 20 acres.

Typically, the surface layer is very dark brown, very friable silt loam about 7 inches thick. The subsurface layer is very dark brown silt loam about 20 inches thick. The subsoil is about 33 inches thick. The upper part is brown silt loam, the middle part is yellowish brown and dark yellowish brown silt loam, and the lower part is grayish brown silt loam to a depth of about 60 inches. In places the dark surface soil is less than 24 inches thick. In places immediately downslope from outcrops of sandstone, the surface layer is fine sandy loam. In places the soil is moderately well drained.

Included with this soil in mapping are small areas of well drained and moderately well drained Eitzen soils, well drained Eyota soils, and somewhat poorly drained Littleton soils. The Eitzen soils have a thick mantle of stratified, silty erosional sediment. They are near floodways and make up 1 to 5 percent of mapped areas. The Eyota soils have more sand in the upper part of the profile than this Lindstrom soil. They are typically on more convex positions and make up 2 to 5 percent of mapped areas. The Littleton soils are silty. They are on positions similar to those of this Lindstrom soil and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. The content of phosphorus and potassium in the subsoil is medium. Reaction is neutral through medium acid in the surface layer and subsoil. The content of organic matter in the surface layer is moderate or high. The water table is below a depth of 6 feet in all seasons. The rooting zone is more than 60 inches deep. This soil warms early in the growing season. It is easy to till. The range in soil moisture suitable for tillage is moderately wide.

Most areas of this soil are used for cropland, but a small acreage is used for pasture. Corn is the most common crop grown, but alfalfa-grass forage and small grain are also grown. This soil is well suited to row crops and small grain. Row crops can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. The major concern in managing this soil is the overflow of surface water, which can damage crops and deposit sediment during hard rains. This can be overcome in most places by constructing grassed waterways. Some places need dams to prevent overflow. Fall or spring plowing or chisel plowing is well suited to this soil. Leaving large amounts of crop residue on the surface, keeping tillage to a minimum, and applying manure help control erosion and maintain friability and moisture content.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Most areas of pasture are in bluegrass. The pasture in these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forages efficiently and maintain the sod in good condition.

This soil is suitable for building site development and septic tank absorption fields. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the hazard of frost action.

This soil is in capability class I.

301C—Lindstrom silt loam, 6 to 12 percent slopes. This well drained, sloping soil is on foot slopes below the steep to very steep sides of ridges. Slopes are plane or concave. Areas are long and narrow and wind around the base of ridges. Areas range from 3 to about 15 acres.

Typically, the surface layer is very dark brown silt loam about 15 inches thick. The subsurface layer is very dark brown and dark brown silt loam about 24 inches thick. The subsoil to a depth of about 60 inches is dark yellowish brown and yellowish brown, friable silt loam. The surface layer is fine sandy loam in a few places. Some areas are moderately well drained. In places the surface layer is less than 24 inches thick.

Included with this soil in mapping are small areas of well drained Eitzen soils, well drained and moderately well drained Eyota soils, and well drained Plainfield Variant soils. The Eitzen soils formed partly in a mantle of stratified, silty erosional sediment and are in drainageways. They make up 1 to 2 percent of mapped areas. The Eyota soils contain more sand than this Lindstrom soil and are typically downslope from sandstone outcrops. They make up 1 to 5 percent of mapped areas. The Plainfield Variant soils formed partly in a sandy mantle and typically are downslope from noses or points of south- or southwest-facing sandstone outcrops. They make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. The availability of phosphorus and potassium in the subsoil is medium. The surface layer and subsoil are neutral through medium acid. The content of organic matter in the surface layer is high. The water table is below a depth of 6 feet in all seasons. The rooting zone is more than 60 inches deep. This soil warms and dries early in the growing season. It is moderately easy to till. It can be tilled through a fairly wide range of soil moisture.

Most areas of this soil are used for cropland. Corn, alfalfa-grass forage, and small grain are commonly grown. Row crops and small grain are well suited. The main limitation to using this soil for cropland is the hazard of erosion. Erosion can be controlled by farming across the slope or on the contour, using terraces, growing occasional sod-producing crops, and using tillage methods that leave large amounts of crop residue on the soil surface. Applying manure helps maintain fertility and a friable surface that is easy to till and absorbs water readily. Drainageways can develop into gullies unless they are shaped, seeded, and maintained as grassed waterways. Water overflow from the steeper soils upslope damages crops in places. Terraces and diversions can be used to carry water away without causing crop damage.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and pasture production can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the hazard of frost action. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe.

312B—Shullsburg silt loam, 1 to 6 percent slopes. This somewhat poorly drained, gently sloping soil is on the top of narrow ridges and mesalike hills. Slopes range from convex to concave. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 13 inches thick. The upper part is dark yellowish brown, mottled silty clay loam, and the lower part is light olive brown, mottled silty clay. The underlying material to a depth of about 60 inches is pale olive, weathered shale. The silty mantle is as much as 50 inches thick in places. Some spots are poorly drained.

Included with this soil in mapping are small areas of well drained Edmund and Frankville soils. These soils are underlain by limestone. They are on positions similar to those of this Shullsburg soil and make up about 2 to 5 percent of mapped areas.

Water and air move through this soil at a slow rate. Surface runoff is medium. The available water capacity is moderate. The availability of phosphorus and potassium in the subsoil is medium. The subsoil is medium acid through neutral. The content of organic matter in the surface layer is high. The rooting zone extends to the firm, silty clay and clay subsoil or to the perched water table. The perched water table is at a depth of 1 to 3 feet for short periods during wet seasons. This soil warms and dries somewhat slowly in spring. It is moderately difficult to till.

Most areas of this soil are used for cropland and pasture. A few areas are in woodland. Most areas are small and are managed with the dominant nearby soils. Corn, alfalfa-grass forage, and small grain are the commonly grown crops. This soil has fair suitability for row crops, such as corn and soybeans. The main limitations are seasonal wetness and a moderate hazard of erosion. Tillage within the proper range of soil moisture is important. Corn and soybeans suffer from drought in some years because the silty or clayey lower part of the subsoil holds water too tightly and only a limited amount of water is available for plants. Controlling erosion helps maintain the friable silty mantle, which provides the rooting zone and accounts for much of the available water capacity. Erosion can be controlled by including forage crops in the rotation and farming on the contour. Returning crop residue and applying manure increase the soil moisture available for plants and improve fertility. A few areas have drainageways crossing this soil. Drainageways should be shaped, seeded, and maintained as grassed waterways to prevent gullies from forming.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage. Wetness can cause root rot in alfalfa. Many areas of pasture are in bluegrass and can be improved by seeding to more productive species. To avoid soil compaction, grazing should be delayed in spring and restricted during wet seasons until the soil is firm. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants also increase pasture production. Forage can be utilized efficiently and sod maintained in good condition by proper stocking rates and rotating pasture.

Basements and the lower level of buildings should be constructed above the seasonal high water table. Tile drains around foundations help to remove the excess subsurface water. Landscaping needs to be designed to drain surface water away from buildings. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table and the depth to bedrock and because the permeability of this soil restricts it from readily absorbing effluent. Placing distribution lines in a mound of more suitable fill material helps overcome these limitations.

This soil is in capability subclass IIe.

312C—Shullsburg silt loam, 6 to 12 percent slopes. This somewhat poorly drained, sloping soil is on the top of narrow ridges or on mesalike hills. Slopes are long and smooth and range from convex to concave. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 13 inches thick. The upper part is dark yellowish brown, mottled silty clay loam, and the lower part is light olive brown, mottled silty clay. The underlying material is pale olive, very firm, weathered shale to a depth of about 60 inches. The silty mantle is more than 30 inches thick in places. Some areas are poorly drained.

Included with this soil in mapping are small areas of well drained Edmund and Frankville soils. The Frankville and Edmund soils are underlain by limestone. They are on positions similar to those of this Shullsburg soil and make up about 2 to 4 percent of mapped areas.

Water and air move through this soil at a slow rate. Surface runoff is medium. The available water capacity is moderate. The availability of phosphorus and potassium in the subsoil is medium. The subsoil is medium acid through neutral. The content of organic matter in the surface layer is high. The rooting zone extends to the firm silty clay and clay subsoil or to the perched water table. The perched water table is at a depth of 1 to 3 feet for short periods during wet seasons. This soil warms and dries slowly in spring. It is moderately difficult to till.

Most areas of this soil are used for cultivated crops, forage crops, and pasture. A few areas are in woodland. Most areas are small and are managed with the dominant soils nearby. This soil has fair suitability for row crops, such as corn. The main management concerns are the limited moisture supply and the severe hazard of erosion. Controlling erosion helps maintain the friable silty mantle, which provides the rooting zone and holds much of the available water. Erosion can be controlled by including forage crops in a rotation with corn or other row crops. Growing forage crops and corn in alternating

strips on the contour is well suited to controlling erosion on the long, smooth slopes. Returning large amounts of crop residue and applying manure increase the intake of moisture and improve fertility. Drainageways should be shaped, seeded, and maintained as grassed waterways to prevent gullies from forming.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yields and quality of forage. Many areas of pasture are in bluegrass and can be improved by seeding to more productive species. To avoid soil compaction, grazing should be delayed in spring and restricted during wet seasons until the soil is firm. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds increase the growth and production of pasture. Forage can be utilized efficiently and the sod maintained in good condition by using proper stocking rates and rotating pasture.

Basements and the lower level of buildings should be constructed above the seasonal high water table. Tile drains around foundations help remove the excess subsurface water. Landscaping needs to be designed to drain surface water away from buildings. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table and depth to bedrock and because the permeability of this soil restricts it from readily absorbing effluent. Placing distribution lines in a mound of more suitable fill material helps to overcome these limitations.

This soil is in capability subclass IIIe.

322D2—Timula silt loam, 12 to 20 percent slopes, eroded. This well drained, moderately steep soil is on short slopes on the sides of terraces. Slopes are mostly convex. Areas are long and narrow and range from 3 to about 7 acres.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is dark yellowish brown silt loam about 26 inches thick. The underlying material is light olive brown silt loam to a depth of about 60 inches. Most areas of pasture and woodland have not been eroded. Areas that have never been tilled have a very dark grayish brown surface layer 6 to 10 inches thick.

Included with this soil in mapping are small areas of well drained and moderately well drained Chaseburg soils and poorly drained Newalbin soils. The Chaseburg and Newalbin soils formed in stratified sediment in drainageways. The Chaseburg soils make up 1 to 5 percent of mapped areas, and the Newalbin soils make up 1 to 2 percent.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is rapid. The availability of phosphorus and potassium in the subsoil is medium. The solum is slightly acid through mildly alkaline. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in spring and is easy to till.

Most areas of this soil are used for cropland or pasture. This soil is only fairly suited to row crops because of the hazard of erosion and steepness of slope. Erosion can be controlled by a cropping sequence consisting mostly of forage crops and an occasional row crop, such as corn. Tillage methods that leave large amounts of crop residue on the surface, farming on the contour, and applications of manure reduce soil loss and increase intake of air and water. Most areas of this soil are too small and slopes are too short to contour stripcrop.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and pasture production can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Only a few areas of this soil are in woodland; however, trees grow well if plant competition is controlled. This can be done by spraying with approved herbicides or by cultivation. There are no important limitations to harvesting trees.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Roads constructed on this soil need to be placed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Using well compacted, coarse textured base material helps protect the roads from frost damage. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IVe.

322E—Timula silt loam, 20 to 40 percent slopes. This well drained, steep to very steep soil is on the sides of terraces. Slopes are short and convex. Gullies cross this soil at irregular intervals. Areas are long and narrow and range from 3 to about 10 acres.

Typically, the surface layer is dark brown silt loam about 10 inches thick. The subsoil is yellowish brown silt loam about 24 inches thick. The underlying material to a depth of about 60 inches is light olive brown, calcareous silt loam. A few small areas have a surface layer as much as 20 inches thick. Many areas have been eroded and as a result have a surface layer that is a brown mixture of surface soil and subsoil. Small areas on strongly convex surfaces have free lime at the surface. Small areas are coarser or finer textured than this Timula soil. In places on the lower part of the slope, the soils are underlain by sand within a depth of 40 inches.

Included with this soil in mapping are small areas of well drained and moderately well drained Chaseburg soils and poorly drained Newalbin soils. The included soils formed in stratified sediment. They are in narrow drainageways and gully bottoms and make up about 2 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is very rapid. The solum is slightly acid through mildly alkaline. The availability of phosphorus and potassium in the subsoil is medium. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more.

Most areas of this soil are used for pasture. Some areas are in woodland. Row crops are poorly suited because of the severe hazard of erosion and steepness of slope. Suitability is fair for pasture. Grazing needs to be carefully managed to maintain a dense sod cover. If the plant cover becomes thin, gullies develop easily and are difficult to stabilize. Productivity of pasture decreases during the warm summer because of insufficient moisture. The very steep slopes severely limit the use of machinery to apply herbicides, fertilizer, and seed. Maintaining a dense sod cover and allowing plants to reach the proper height before grazing increase forage production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain sod in good condition.

This soil is well suited to woodland, but areas are generally small and are managed with the adjacent soils. Existing woodlands that can be managed should have undesired plants removed to allow for restocking or replanting of preferred trees. Natural regeneration of hardwoods is difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves surface tilth and maintains the spongelike mulch of leaves that helps absorb precipitation and reduce runoff. Competing vegetation needs to be controlled to allow for maximum growth in new plantings. Spraying with approved herbicides is a common practice for this purpose. Thinning at the proper time also improves growth. Because slopes are short, there are no important limitations for harvesting. Access is available from more gentle slopes in downslope and upslope areas.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and lots should be designed to conform to the natural slope of the land. Roads constructed on this soil need to be placed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Using well compacted, coarse textured base material helps protect the roads from frost damage. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass VIe.

388C2—Seaton silt loam, valleys, 6 to 12 percent slopes, eroded. This well drained, sloping soil is on foot slopes. Slopes are concave to convex. Areas are long and narrow and range from 5 to about 20 acres.

Typically, the surface layer is grayish brown silt loam about 8 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is friable silt loam about 40 inches thick. The upper part is brown and yellowish brown, and the lower part is grayish brown and light olive brown. The underlying material to a depth of about 60 inches is grayish brown, friable silt loam. Most areas in pasture and woodland have not been eroded. In places the surface layer and upper part of the subsoil are loam. The most severely eroded, convex parts of the slope have a brown surface layer that is low in organic matter and less friable. In a few small concave areas, the surface layer is thicker and darker colored.

Included with this soil in mapping are small areas of well drained and moderately well drained Chaseburg soils. The Chaseburg soils formed in stratified silty alluvium. They are in drainageways and make up about 1 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is low. The subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons. This soil warms and dries early in the growing season. It is moderately easy to till. The range in soil moisture suitable for tillage is moderately wide. This soil is easily eroded. Also, the surface layer tends to puddle during rains and form a crust upon drying. The crust reduces

intake of air and water. A friable surface layer is difficult to maintain.

Most areas of this soil are used for cropland. Some areas are in pasture and woodland. Alfalfa-grass forage, corn, and small grain are commonly grown. Suitability is fair for row crops, such as corn. The main limitation is the hazard of erosion. Erosion control practices are needed where corn is grown. Corn can be grown satisfactorily every year if erosion is controlled. Growing forage crops and corn in alternating strips on the contour, terracing, and methods of tillage that leave large amounts of crop residue on the surface help control erosion and are well suited to the long, smooth slopes of this early warming soil. Applications of manure reduce soil loss and crusting and increase fertility in this soil. In many places diversions are needed along the upper parts of fields to prevent overflow from causing gullies and damaging seeded fields. Shaping and seeding drainageways to grassed waterways help prevent gullies from forming.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

Trees are well suited to this soil, but only a few areas are in woodland. Some woodlands are grazed and can be improved by limiting grazing, which lowers natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for restocking of preferred trees. Plant competition is severe in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage or by careful spraying with herbicides.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe.

388D2—Seaton silt loam, valleys, 12 to 20 percent slopes, eroded. This well drained, moderately steep soil is on foot slopes. Slopes are mainly concave but range to convex. Areas are long and narrow and range from 5 to about 20 acres.

Typically, the surface layer is brown silt loam about 9 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is dark brown, dark yellowish brown, and yellowish brown, friable silt loam about 43 inches thick. The underlying material to a depth of about 60 inches is light olive brown, friable silt loam. Most areas in pasture and woodland have not been eroded. In places the surface layer and upper part of the subsoil are loam or sandy loam. Small areas are underlain by cobbly gravelly loam or sandy loam at a depth of less than 60 inches. Small fragments of sandstone are in the lower part of the subsoil in places. The most severely eroded, convex parts of the slope have a brown surface layer that is low in organic matter and less friable. A few small concave areas have a darker colored surface layer more than 10 inches thick.

Included with this soil in mapping are small areas of Chaseburg and La Farge soils. The Chaseburg soils formed in silty, stratified alluvium. They are in narrow drainageways and make up 1 to 2 percent of mapped areas. The La Farge soils are on positions similar to those of this Seaton soil, but the slopes are typically more convex. The La Farge soils are underlain by sandstone within a depth of 40 inches. They make up less than 1 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is rapid. In the subsoil the availability of phosphorus is very high and potassium is low. The surface layer is neutral through medium acid, and the subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches in most places. This soil warms and dries early in the growing season and is moderately easy to till. The range in soil moisture suitable for tillage is moderately wide. This soil is easily eroded. Also, the surface layer tends to puddle during rains and form a crust upon drying. The crusting reduces intake of air and water. A friable surface layer is difficult to maintain.

Most areas of this soil are used for cropland. Corn, alfalfa-grass forage, and small grain are the common crops. Suitability is poor for row crops, such as corn. The hazard of erosion is the main limitation. Hay and forage crops are better suited than row crops to this soil. To control erosion, row crops should be grown in a rotation consisting mostly of forage crops. Growing corn and forage crops in alternating strips on the contour helps control erosion on this soil. Tillage methods that leave large amounts of crop residue on the surface and

applications of manure reduce erosion, help maintain a friable surface, and increase intake of air and water. In many places diversions are needed along the upper parts of fields to prevent overflow from upslope from causing gullies and damaging seedlings. Shaping and seeding drainageways to grassed waterways help prevent the formation of gullies.

This soil is well suited to forage crops and pasture. Pasture in many areas can be improved by planting to more productive grasses or legumes. Crops respond well to lime and the proper amount and kinds of fertilizer. Pasture can be improved with equipment that plants directly into sod. This reduces the hazard of erosion during the renovation period and reduces the number of operations needed. Adapted varieties, a proper supply of nutrients, allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Trees are well suited to this soil, but only a few areas are in woodland. Some areas are grazed and can be improved by limiting livestock grazing, which lowers natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for restocking or replanting of preferred trees. Plant competition is severe in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage or by careful spraying with herbicides.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Roads should be constructed on the contour, where possible, and roadbanks need to be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IVe.

388E—Seaton loam, valleys, 20 to 30 percent slopes. This steep, well drained soil is on the upper part of foot slopes below the steep to very steep sides of ridges along stream valleys. Slopes are plane to slightly concave. Gullies and narrow drainageways cross this soil at irregular intervals. Areas are long and narrow and wind around the base of the side slopes. They range from 5 to about 40 acres.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsurface layer is dark brown, friable silt loam about 3 inches thick. The subsoil is yellowish brown, friable silt loam about 31 inches thick. The underlying material is light olive brown silt loam to a depth of about 60 inches. Some areas have been eroded, and the cultivated layer is lower in content of organic matter and less friable. In many places the subsurface layer and subsoil are loam. In areas a few pebbles and cobbles are on the surface. In places the soil is underlain by cobbly loam or cobbly fine sandy loam within a depth of 60 inches.

Included with this soil in mapping are small areas of well drained to moderately well drained Beavercreek and Chaseburg soils and well drained Eleva and Norden soils. The Beavercreek soils are cobbly throughout, and the Chaseburg soils are silty throughout. These soils are in narrow drainageways and make up 1 to 2 percent of mapped areas. The Eleva soils are underlain by sandstone within a depth of 40 inches, and the Norden soils have a loamy subsoil, which is weathered from sandstone. These Eleva and Norden soils are on strongly convex knobs, and each makes up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is high, and surface runoff is rapid. In the subsoil the availability of phosphorus is medium and potassium is low. The subsoil is slightly acid or medium acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of more than 60 inches.

Most areas of this soil are used for forage crops or pasture. Suitability is fair for these uses. This soil is too steep for row crops. The hazard of erosion and limited intake of water because of rapid runoff are major limitations. Most cleared areas of this soil are in bluegrass pasture, which is unproductive during the warm, dry summer. Legumes are more productive than the bluegrass. The hazard of erosion is severe where pasture is renovated or forage crops are replanted. Erosion can be reduced during renovation or reseeding periods by using tillage methods that leave large amounts of sod residue on the surface. Applying strawy manure as a mulch after seeding helps control erosion. Seeding mixtures that contain a high proportion of grasses produce a dense, erosion-resistant sod. Interseeding legumes directly into grasses improves pasture quality. Allowing plants to reach the proper height before grazing or harvesting increases the yield and quality of forage or pasture. Controlling weeds and clipping mature plants where slopes allow the use of mechanical equipment also increase yields of pasture. Using proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition. Because this soil erodes easily, careful management is needed to avoid damaging the protective sod by overgrazing.

This soil is well suited to trees. The major limitation is steepness of slope, which limits the use of mechanical planting equipment. Hardwoods native to the area, such

as northern red oak, are better suited than many other species. In places clearing of undesired trees is essential to allow for restocking or replanting of preferred trees. Natural regeneration of hardwoods can be difficult because of destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves the friability of the surface layer and maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff. This increases moisture for tree growth and improves natural regeneration beneath the existing forest canopy. In new plantings, competing plants need to be controlled to allow for good growth. This can be accomplished through the careful use of herbicides. Thinning at the proper times helps produce optimum growth. Care must be taken when harvesting trees to control erosion. Constructing logging roads on the contour wherever possible minimizes the hazard of runoff.

Slope is the main limitation to the use of this soil for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Roads should be constructed on the contour, where possible, and roadbanks need to be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass VIe.

388F—Seaton loam, valleys, 30 to 45 percent slopes. This well drained, very steep soil is on the upper part of foot slopes below very steep sides of ridges along stream valleys. Narrow drainageways and gullies cross this soil at irregular intervals. Areas are long and narrow and wind around the base of the very steep side slopes. They range from 5 to about 60 acres.

Typically, the surface layer is very dark brown loam about 3 inches thick. The subsurface layer is dark grayish brown loam about 4 inches thick. The subsoil is silt loam about 35 inches thick. The upper part is brown, and the lower part is dark yellowish brown. The underlying material to a depth of about 60 inches is light olive brown silt loam. In some areas a few pebbles and cobbles are on the surface. In many places the subsurface layer and subsoil are loam. In places the soil is underlain by cobbly loam within a depth of 40 inches. In places sandstone is within a depth of 60 inches.

Included with this soil in mapping are well drained and moderately well drained Beavercreek and Chaseburg soils and well drained Norden soils. The Beavercreek soils are cobbly throughout, and the Chaseburg soils are silty throughout. These soils are in narrow drainageways and make up 2 to 5 percent of mapped areas. The Norden soils have a loamy subsoil weathered from sandstone. These soils are on strongly convex surfaces and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. Surface runoff is very rapid. The available water capacity is high. In the subsoil the availability of phosphorus is high and potassium is low. The surface layer is slightly acid or medium acid, and the subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low. The rooting zone extends to a depth of more than 60 inches.

Nearly all areas of this soil are used for trees. This soil is not suited to cropland. Steepness of slope is the main limitation. The highest potential use of this soil is for growing hardwoods native to the area. Clearing of undesired trees in stands is needed in places, to allow for restocking or replanting of preferred trees. Thinning at the proper times helps produce optimum growth. Natural regeneration of hardwoods can be difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves the friability of the surface layer and maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff. This increases the moisture for tree growth and improves natural regeneration. In new plantings, competing vegetation needs to be controlled to allow for good growth. This can be accomplished through the careful use of herbicides. Access roads built on the contour minimize the hazards of runoff and erosion.

Some areas of this soil are used for pasture but are poorly suited to this use. The severe erosion hazard is the main limitation. Gullies develop easily in this soil. This soil is too steep to renovate with farm machinery. Erosion can be controlled by careful control of stocking rates and good grazing management.

This soil is generally not suitable for building sites, local roads, or septic tank absorption fields because of steepness of slope.

This soil is in capability subclass VIIe.

401B—Mt. Carroll silt loam, 3 to 6 percent slopes. This well drained, gently sloping soil typically is on the crest of ridges and less commonly on foot slopes above the upper reaches of drainageways. Slopes are convex on the summits and concave on the foot slopes. Areas are irregular in shape and range from 5 to about 40 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable silt loam about 48 inches thick. The underlying material to a depth of about 60 inches is yellowish brown or light olive brown silt loam. In a few areas where the slope is strongly convex, the surface layer is dark brown as a result of

erosion. In a few places the surface layer is very dark brown and as much as 12 inches thick. In some areas where the slope is concave, the soil is moderately well drained.

Included with this soil in mapping are small areas of well drained Frankville soils and moderately well drained and well drained Massbach soils. The Frankville soils are underlain by clayey residuum, and the Massbach soils have shale residuum at a depth as shallow as 30 inches. These soils are on narrow ridges on positions similar to those of this Mt. Carroll soil. They make up 5 to 15 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is very high and potassium is low. The surface layer is neutral through medium acid, and the subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderate. The water table is at a depth below 6 feet in all seasons. The rooting zone extends to a depth of 60 inches in most places. This soil warms and dries early in the growing season. It is moderately easy to till. This soil is easily eroded. Also, the surface layer tends to puddle during rains and forms a crust upon drying. Crusting reduces the intake of air and water.

Most areas of this soil are used for cropland. Corn is the most common crop, but alfalfa-grass forage, soybeans, and small grain are also grown. This soil is well suited to row crops, such as corn. The main limitation to row crops is the moderate hazard of erosion because of the long slopes and easily erodible soil. Row crops can be grown satisfactorily every year if erosion is controlled, fertility is maintained, and weeds, insects, and diseases are controlled. Erosion can be controlled and crusting reduced by using tillage methods that maintain large amounts of crop residue on the surface. Including occasional sod-forming crops in the rotation also reduces erosion. Slopes are long and smooth in most places and are well suited to contour tillage and terraces. Applications of manure reduce soil loss, improve fertility, and increase intake of air and water.

This soil is well suited to forage crops and pasture. Suitable varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few areas of this soil are used for pasture and are mainly in bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize forage efficiently and maintain the sod in good condition.

This soil is not generally used for woodland but is well suited to trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is suitable for building site development and septic tank absorption fields. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action.

This soil is in capability subclass IIe.

401C—Mt. Carroll silt loam, 6 to 12 percent slopes. This well drained, sloping soil is on ridgetops. Slopes are convex. Areas are elongated and range from 4 to about 50 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is brown, dark yellowish brown, and yellowish brown, friable silt loam about 44 inches thick. The underlying material to a depth of about 60 inches is brown, mottled silt loam. In some areas where the slope is strongly convex, the original surface soil has been eroded, resulting in a dark brown or dark yellowish brown surface layer. In a few areas where the slope is concave, the surface layer is more than 10 inches thick, or the soil is moderately well drained, or both.

Included with this soil in mapping are small areas of well drained and moderately well drained Eitzen and Massbach soils and well drained Frankville soils. The Eitzen soils are stratified and in drainageways. The Frankville soils are underlain by clayey residuum. The Massbach soils are underlain by shale residuum at a depth of 30 to 50 inches. Frankville and Massbach soils are on positions similar to those of this Mt. Carroll soil. The included soils make up 1 to 10 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is very high and potassium is low. The surface layer is neutral through medium acid, and the subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderate. The water table is at a depth below 6 feet. The rooting zone extends to a depth of 60 inches in most places. This soil warms and dries early in the growing season. It is moderately easy to till. This soil is easily eroded. Also, the surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces the intake of air and water.

Most areas of this soil are used for cropland. Corn, alfalfa-grass forage, and small grain are the commonly grown crops. Suitability is fair for row crops, such as corn. The severe erosion hazard is a limitation. Corn can be grown satisfactorily every year in places where

erosion has been controlled. Terraces and tillage methods that leave large amounts of crop residue on the surface are used in combination to help control erosion and are well suited to this soil. Growing forage crops and corn in alternating strips on the contour help to control erosion. Applications of manure reduce soil loss and crusting and improve soil fertility. Shaping and seeding drainageways to grassed waterways help prevent the formation of gullies.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Most areas of pasture are in bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This soil is not generally used for woodland but is well suited to trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe.

401D—Mt. Carroll silt loam, 12 to 20 percent slopes. This well drained, moderately steep soil is on ridgetops. Slopes are convex. Areas are elongated and range from 4 to about 20 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is dark brown and dark yellowish brown, friable silt loam about 28 inches thick. The underlying material to a depth of about 60 inches is yellowish brown or light olive brown silt loam. On some strongly convex slopes the original surface has been eroded, resulting in a dark brown or dark yellowish brown surface layer.

Included with this soil in mapping are small areas of well drained and moderately well drained Eitzen soils and well drained Frankville soils. The Eitzen soils are stratified and in drainageways. The Frankville soils are underlain by clayey residuum and are in positions similar to those of this Mt. Carroll soil. The included soils each make up 1 to 2 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is rapid. In the subsoil the availability of phosphorus is very high and potassium is low. The surface layer is neutral through medium acid, and the subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderate. The water table is below a depth of 6 feet. The rooting zone extends to a depth of 60 inches in most places. This soil warms and dries early in the growing season and is moderately easy to till. This soil is easily eroded. Also, the surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces the intake of air and water.

Most areas of this soil are used for cropland. Some areas are in pasture. Corn, alfalfa-grass forage, and small grain are common crops. Row crops, such as corn, are poorly suited because of the hazard of erosion. Erosion can be controlled if corn is grown in a crop rotation consisting mostly of forage crops. Growing corn with forage crops in alternating strips on the contour is effective in erosion control and well adapted to the long, smooth slopes. Tillage methods that leave large amounts of crop residue on the surface all year long and applications of manure reduce soil loss, improve fertility, and reduce soil crusting, thus increasing the intake of air and water. Gullies develop easily in this soil. Gullies can be prevented by shaping, seeding, and maintaining drainageways crossing this soil as grassed waterways.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Most areas of pasture are in bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This soil is not generally used for woodland but is well suited to trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

Slope is the main limitation to the use of this soil as building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Roads need to be constructed on the contour, where possible, and roadbanks should be planted to well adapted grasses to

minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IVe.

455A—Festina silt loam, 0 to 2 percent slopes. This well drained, nearly level soil is on broad stream terraces. Slopes are mostly plane. Areas are irregular in shape and range from 5 to about 50 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil extends to a depth of 60 inches. The upper 20 inches is brown and dark yellowish brown silt loam, and the lower part is olive brown, mottled silt loam. In a few places the surface layer is as much as 20 inches thick.

Included with this soil in mapping are somewhat poorly drained Littleton soils and poorly drained Walford and Walford Variant soils. The Littleton soils are on plane to slightly concave positions, and the Walford and Walford Variant soils are in shallow drainageways. The included soils each make up about 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is slow. In the subsoil the availability of phosphorus is high or very high and potassium is low or medium. The subsoil is slightly acid or medium acid. The content of organic matter in the surface layer is moderate. The seasonal high water table is below a depth of 6 feet. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season. It is moderately easy to till. The range in soil moisture suitable for tillage is wide. The surface layer tends to puddle during rains and forms a crust upon drying. The crusting further reduces intake of air and water.

Most areas of this soil are used for cropland. Some areas are used for pasture or woodland. Corn, alfalfa-grass forage, and small grain are the main crops grown. Row crops are well suited and can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. The soil responds well to fertilizers. Working the soil at the proper moisture content and returning large amounts of crop residue help reduce crusting and increase the intake of air and water. This soil can be safely tilled in fall. Fall tillage allows freezing and thawing action in winter to break clods formed by tillage.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

Areas of this soil are not generally used for woodland but are well suited to this use. Weeds and other undesirable plants should be controlled to prevent competition with the trees by spraying with herbicides or by tillage.

The foundations and footings of buildings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material helps prevent structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability class I.

455B—Festina silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is in narrow strips at the base of foot slopes and on side slopes at the upper end of drainageways that dissect stream terraces. Slopes are plane to concave at the base of foot slopes and convex on the side slopes. Areas are mostly elongated and range from 3 to about 12 acres.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is silt loam about 37 inches thick. The upper part is dark brown, and the lower part is olive brown and light olive brown. The underlying material is light yellowish brown silt loam to a depth of about 60 inches. In a few places the surface soil is dark brown.

Included with this soil in mapping are small areas of poorly drained Walford and Walford Variant soils. These soils are silty. They are in drainageways and make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is high or very high and potassium is low or medium. The subsoil is slightly acid or medium acid. The content of organic matter in the surface layer is moderate. The seasonal high water table is below a depth of 6 feet. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season. It is moderately easy to till. The range in soil moisture suitable for tillage is moderately wide. The surface layer tends to puddle during rains and forms a crust upon drying. The crusting further reduces intake of air and water.

Most areas of this soil are used for cropland. Some areas are used for pasture and woodland. Corn is the most common crop, but alfalfa-grass forage and small grain are also grown. Most areas are managed with larger areas of nearby Festina soils on nearly level surfaces. This soil is well suited to row crops, which can be grown every year if erosion is controlled, fertility is maintained, and weeds, insects, and diseases are controlled. Working the soil at the proper moisture content and returning crop residue help maintain a friable surface. Erosion can be controlled by growing forage crops in the rotation or by using tillage methods that leave large amounts of crop residue on the surface.

This soil is well suited to forage crops and pasture. Planting suitable varieties, having a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass and can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This soil is well suited to trees. Because the soil is suited to cropland, woodland is restricted to irregular-shaped areas that are difficult to farm. New seedlings need protection from plant competition. This can be done by careful spraying with herbicides or by using tillage methods.

The foundations and footings of buildings should be designed to prevent structural damage caused by shrinking and swelling of this soil. Backfilling around foundations with suitable coarse material helps provide added assurance against structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability subclass IIe.

455C2—Festina silt loam, 6 to 12 percent slopes, eroded. This well drained, sloping soil typically is on the upper parts of terrace side slopes. Slopes are mostly convex. Areas are mainly elongated and range from 3 to about 10 acres.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is olive brown and light olive brown silt loam about 24 inches thick. It has strong brown mottles in the lower part. The underlying material to a depth of 60 inches is grayish brown, light olive brown, and olive gray silt loam. In areas where slopes are strongly convex, the surface layer is olive brown.

Included with this soil in mapping are small areas of well drained and moderately well drained Chaseburg soils. The Chaseburg soils are subject to flooding and are in drainageways. They make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is high or very high and potassium is low or medium. The subsoil is slightly acid or medium acid. The content of organic matter in the surface layer is moderately low. The seasonal high water table is below a depth of 6 feet. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season. It is moderately easy to till. The range in content of soil moisture suitable for tillage is moderately wide. The surface layer tends to puddle during rains and forms a crust upon drying. The crusting further reduces intake of air and water.

Most areas of this soil are used for cropland. A few small areas are used for pasture and woodland. Crops commonly grown are corn, alfalfa-grass forage, and small grain. Suitability is fair for row crops. The hazard of erosion is the main management concern. Erosion can be controlled and intake of water increased by including forage crops in the cropping sequence and using tillage methods that leave large amounts of crop residue on the surface. Applications of manure reduce erosion and improve fertility.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass. The pasture in many of the areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This soil is well suited to trees. Because most areas of this soil are in cropland, woodland is restricted to irregular-shaped areas that are difficult to farm. New seedlings need protection from plant competition. This can be done by careful spraying with herbicides or by using tillage methods.

Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the

low strength of this soil and from the hazard of frost action. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe.

457E—Lacrescent flaggy silt loam, 20 to 35 percent slopes. This well drained, steep to very steep soil is mainly on the sides of narrow ridges. In a few places it is on short slopes on the sides of ridges along drainageways near the upper reaches of drainage systems. Slopes are mostly convex. Areas are long and narrow and range from 3 to about 10 acres.

Typically, the surface layer is very dark gray and very dark grayish brown flaggy silt loam about 12 inches thick. The subsoil is brown channery silt loam about 7 inches thick and contains about 45 percent flags and channers. The underlying material is yellowish brown very flaggy loam about 31 inches thick and contains about 65 percent channers and flags. Limestone bedrock is at a depth of about 48 inches. In places the limestone bedrock is at a shallower depth. Small areas have a sandy loam surface. Where slopes are slightly concave or plane, the soil is very dark brown silt loam as much as 25 inches thick.

Included with this soil in mapping are small areas of well drained Eleva, Etter, Lindstrom, Norden, and Sogn soils. The Eleva and Etter soils are loamy and underlain by sandstone. The Lindstrom soils are silty and on foot slopes. The Norden soils are loamy and underlain by platy sandstone. The Sogn soils are silty and shallow to limestone bedrock. The included soils are on positions similar to those of this Lacrescent soil. All these soils make up 5 to 15 percent of mapped areas, and the outcrops of limestone and sandstone make up 1 to 2 percent.

Water and air move through this soil at a moderate rate. The available water capacity is low. Surface runoff is rapid. The availability of phosphorus and potassium in the subsoil is low. The surface layer and subsoil are neutral. The content of organic matter in the surface layer is moderate or high. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 10 to 20 inches. The large amount of limestone fragments limits root growth.

Most areas of this soil are in pasture or woodland. This soil is generally not suited to cropland because of the steep and very steep slopes. Suitability is poor for pasture. Productivity is limited by the low available water capacity and limited intake of moisture because of the rapid runoff. Because of the numerous flags on the surface and the steep and very steep slopes, pasture renovation is difficult. Most areas of pasture consist of bluegrass. Pasture productivity can be improved by allowing plants to reach the proper height before grazing, stocking at the proper rate, and rotating pasture.

This soil is poorly suited to use as woodland. Many areas consist of narrow strips of woodland that are grazed along with the more productive soils upslope and downslope. Woodland productivity is low, limited mostly by the shallow depth to flaggy soil and by the low available water capacity. Many areas are small and not practical to manage for forestry purposes. Removing livestock and planting suitable tree species provide good habitat for wildlife, such as squirrels, deer, and upland game birds. Plant competition should be controlled in new plantings.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed when constructing roads on this soil. Roads should be placed on the contour, and roadbanks need to be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass VIe.

457G—Lacrescent cobbly silty clay loam, 45 to 70 percent slopes. This well drained, very steep soil is on the sides of ridges along stream valleys. Slopes are long and mostly convex. Outcrops of rock are common. Areas are long and range from about 5 to 100 acres. They are dissected by many gullies and drainageways at irregular intervals.

Typically, the surface layer is black cobbly silty clay loam about 10 inches thick. The subsurface layer is very dark grayish brown cobbly silt loam about 7 inches thick. The subsoil is dark brown very cobbly silt loam about 11 inches thick. The underlying material to a depth of about 60 inches is light olive brown very cobbly silt loam. In small areas the surface layer is sandy loam. In places sandstone or limestone is within a depth of 40 inches. In areas where the surface is slightly concave or plane, the soil is very dark brown to a depth of 25 inches or more. Small areas, generally on the south- or west-facing slopes, have free carbonates near the surface.

Included with this soil in mapping are small areas of well drained and moderately well drained Beavercreek soils and well drained Boone, Council, Elbaville, Lamoille, and Seaton soils. The Beavercreek soils are in drainageways and do not have a dark colored surface layer. The Boone soils are sandy and are on positions similar to those of this Lacrescent soil. The Council and Elbaville soils are loamy and on foot slopes. The Lamoille soils have a clayey subsoil and are on positions similar to those of this Lacrescent soil. The Seaton soils do not have coarse fragments and are on foot slopes. Also included are small areas of outcrops of sandstone and limestone. The included soils and the outcrops make up about 10 to 15 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is low. Surface runoff is very rapid. The availability of phosphorus and potassium in the subsoil is low or medium. The surface layer and subsoil are neutral. The content of organic matter in the surface layer is moderate or high. The water table is below a depth of 6 feet in all seasons. Roots develop easily in the upper 10 to 20 inches of this soil, but root growth is somewhat limited below this depth by the many limestone cobbles and pebbles.

Most areas of this soil are used for woodland, some of which is pastured. This soil has fair suitability for woodland. It has poor suitability for cropland and pasture because of the very steep slopes. Woodland productivity is limited by the low available water capacity and low intake resulting from the very rapid runoff. Shallow rooting depth is also a limitation. The elimination of grazing helps increase the intake of moisture. It helps maintain or increase the thickness of the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff, thus increasing the moisture available to trees. This also helps improve natural regeneration. In places clearing of undesired trees in stands is essential to the restocking or replanting of preferred trees. Natural regeneration of hardwoods can be difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. In new plantings competing vegetation should be controlled to allow for good growth. This can be accomplished through the careful use of herbicides. Thinning at the proper times helps produce optimum growth. Access roads, if needed, should be built on the contour to minimize hazards of runoff and erosion. They are difficult and costly to build because of the very steep slopes. Specialized harvesting techiques are needed on these very steep slopes. Some areas of this soil are excellent for recreation purposes. Trails that can be developed in some areas offer scenic settings.

Areas of this soil are generally not suitable for building sites, local roads, or septic tank absorption fields because of steepness. Soils that are better suited to these uses are generally nearby.

This soil is in capability subclass VIIe.

463—Minneiska fine sandy loam, occasionally flooded. This moderately well drained, nearly level soil is on flood plains, mainly near the Mississippi River. Slopes are plane to slightly concave and convex. This soil is subject to occasional, brief flooding. Narrow meandering drainageways cross areas at irregular intervals. Areas are irregular in shape and range from 5 to about 40 acres or more.

Typically, the surface layer is very dark brown, calcareous fine sandy loam about 11 inches thick. The underlying material extends to a depth of about 60 inches. The upper part is multicolored, stratified loam, loamy fine sand, and fine sandy loam. The lower part is grayish brown sand that has thin strata of very dark grayish brown and light olive brown loamy sand, sandy loam, and loam. A few small areas are somewhat poorly drained.

Included with this soil in mapping are small areas of moderately well drained Terril soils, well drained and moderately well drained Minneiska Variant and Rawles soils, and poorly drained Kalmarville and Moundprairie soils. The Terril soils are on slightly elevated positions, have a thick dark loamy surface layer, and make up 1 to 5 percent of mapped areas. The Rawles soils are on positions similar to those of this Minneiska soil, are silty throughout, and make up 1 to 3 percent of mapped areas. The Kalmarville and Moundprairie soils are mostly in drainageways and make up 2 to 5 percent of mapped areas. The Kalmarville soils have a loamy mantle overlying stratified sandy and loamy sediment. The Moundprairie soils are silty throughout. The Minneiska Variant soils formed in sandy sediment over loamy sediment and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. The available water capacity is moderate. Surface runoff is slow. The availability of phosphorus and potassium in the underlying material is medium. The soil is mildly alkaline throughout. The content of organic matter in the surface layer is moderate. The depth to the water table is 4 to 6 feet during periods when the river is near flood stage. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season. It is easy to till and can be tilled through a wide range of soil moisture.

Most areas of this soil are used for cropland. Corn is the main crop, but alfalfa-grass forage is also grown. Suitability is fair for row crops. The hazard of flooding and the moderate moisture supply are the main limitations for corn or soybeans. Floods delay planting or damage crops in some years. Some areas of this soil are protected from flooding by dikes. Corn and soybeans can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. Unless rainfall distribution is timely during the warm, dry summer, crops suffer from drought. Excess lime can cause nutrient imbalances that may require extra amounts of phosphorus and potassium and applications of magnesium. Fertility and available moisture can be improved by returning crop residue to the soil. This soil is well suited to irrigation because it absorbs water well and roots develop easily. The flood hazard, however, needs critical consideration before investments are made in irrigation systems.

This soil has fair suitability for forage crops and pasture. Insufficient moisture limits yields in some years. Flooding damages legume stands. Also, excess lime can cause nutrient imbalances that require special attention when planning fertility programs. Potash is generally needed to maintain stands of legumes. A proper supply of nutrients, suitable plant varieties, and harvesting at

the proper stage of growth increase yields of forage and pasture. Most areas of pasture are in bluegrass and can be improved by planting to more productive species. Brush removal is needed in places. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds increase productivity. Forage can be most efficiently used by livestock and the sod maintained in good condition by using proper rates of stocking and by rotating pasture.

Trees are well suited to this soil, but only a few areas are in woodland. The main limitation is the moderate available water capacity. In places undesirable trees and brush need to be removed to establish new plantings. Plant competition from weeds and shrubs is severe but can be controlled by cultivation or by careful spraying with approved herbicides. There are no important limitations to harvesting trees.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding.

This soil is in capability suclass IIw.

471—Root silt loam. This poorly drained and very poorly drained, nearly level soil is along narrow valleys, typically 1 to 3 feet above the channel of flowing creeks. Slopes are plane. This soil is subject to frequent, very brief flooding. The meanders of the creeks have divided areas of this soil into many small tracts. Areas are long and narrow and range from 2 to about 10 acres.

Typically, the surface layer is stratified, dark gray, gray, and grayish brown silt loam about 12 inches thick. The upper part of the underlying material is dark gray, calcareous cobbly sandy loam, and the lower part to a depth of about 60 inches is dark gray very cobbly sandy loam and gravelly loamy sand. In many places much of the surface layer is covered with cobbles and gravel. In some areas the surface layer is black, and in a few areas it is sandy. The cobbly underlying material is below a depth of 20 inches in places.

Included with this soil in mapping are small areas of poorly drained Kalmarville soils. The Kalmarville soils are deeper to cobbly material than this Root soil. They are on similar positions and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate in the upper part and at a very rapid rate in the lower part. Surface runoff is slow. The available water capacity is low. In the subsoil the availability of phosphorus is moderate and potassium is low. The content of organic matter in the surface layer is moderate. The soil is neutral or mildly alkaline throughout. The rooting zone extends to a depth of less than 2 feet in most places. The seasonal high water table is within a depth of 2 feet most of the year.

Most areas of this soil are used for pasture. They are generally not suitable for cropland because of soil wetness and the frequent flooding hazard. A few areas have reed and sedge vegetation. This soil has fair suitability for pasture. The water table is near the surface and provides moisture to shallow-rooted plants, such as bluegrass, throughout the growing season. Because of the high percentage of cobbles on and in the soil, pasture is only moderately productive. The cobbles on the surface make the soil difficult to work. The soil is too wet for legumes. Some areas are level and smooth enough so that fertilizer can be applied by mechanical equipment, but nutrients are easily lost during flooding. Proper stocking rates and rotating pasture utilize forage efficiently and help maintain the sod cover.

This soil is generally not suitable for building site development because of the flooding hazard and because of the shallow depth to the seasonal high water table. More suitable soils are generally nearby. Constructing roads on raised, well compacted, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding, soil wetness, and frost action. This soil is generally not suitable for use as septic tank absorption fields because of flooding and wetness and because this soil does not adequately filter the effluent. Soils that are better suited to this use are generally nearby.

This soil is in capability subclass Vw.

476B—Frankville silt loam, 3 to 6 percent slopes. This well drained, gently sloping soil is on the crest of narrow ridges and mesalike hills. Slopes are long and smooth and mostly convex. Areas are irregular in shape and range from 3 to about 20 acres.

Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer is very dark brown and dark yellowish brown, friable silt loam about 4 inches thick. The subsoil is about 36 inches thick. The upper part is dark yellowish brown, friable silt loam, the middle part is dark brown, firm silty clay, and the lower part is dark brown very flaggy silty clay to a depth of 48 inches. Hard limestone bedrock is at a depth of about 48 inches and extends to a depth of 60 inches or more. The surface layer is black or very dark grayish brown and more than 10 inches thick in places. The silty surface soil and upper part of the subsoil have a combined thickness of less than 18 inches or more than 36 inches in places. The surface soil has many flags in some strongly convex areas. Hard limestone is within a depth of 40 inches in places. Some small areas have a thin layer of shale in the lower part of the subsoil.

Included with this soil in mapping are small areas of well drained and moderately well drained Massbach and Shullsburg soils and well drained Mt. Carroll soils. The Massbach and Shullsburg soils are underlain by shale

and have plane slopes. The Mt. Carroll soils are silty throughout and mostly have plane or slightly concave slopes. The included soils each make up 1 to 5 percent of mapped areas.

Water and air move through the surface soil and upper part of the subsoil at a moderate rate and through the lower part of the subsoil at a slow rate. Surface runoff is medium. The available water capacity is moderate. In the subsoil the availability of phosphorus is high and potassium is low or medium. The surface soil and subsoil are neutral through medium acid. The content of organic matter in the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. Roots develop easily in the silty layer, but root growth is slowed by the clayey subsoil at a depth of 18 to 36 inches. This soil warms and dries early in the growing season. It is moderately easy to till. The range in soil moisture suitable for tillage is moderately wide. Because the surface layer is high in silt, it is easily eroded. Also, the surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces intake of air and water.

Most areas of this soil are used for cropland. Some areas are used for pasture. This soil has fair suitability for row crops, such as corn. Corn, alfalfa-grass forage, and small grain are the common crops. The main limitations are the hazard of erosion and the moderate available water capacity. The hazard of erosion is moderate because of the gentle slopes and easily erodible soil. Because of the limited depth of productive soil, further soil loss is critical. Contour farming, growing occasional forage crops, and using minimum tillage methods that leave large amounts of crop residue on the surface reduce soil erosion and crusting and increase the intake of moisture. Application of manure reduces erosion and crusting and improves fertility. Row crops, such as corn, suffer from drought in most years unless rainfall is timely throughout the growing season. Where corn is grown, plant populations, varieties, and fertilizer rates need to be adjusted to the limited moisture supply. Small grain is well suited to this soil because it can take advantage of the early season moisture.

This soil has fair suitability for forage crops and pasture. The main limitation is the moderate moisture supply. Forage crops make good use of the available moisture and the cooler temperatures in the early and late parts of the growing season. Planting suitable varieties, having a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass. Pasture yields can be increased by planting to more productive species, such as alfalfa or bromegrass. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Trees are well suited to this soil, but areas are not generally used for woodland. Plant competition needs to be suppressed in new plantings. This can be done by careful spraying with herbicides or by cultivating. Existing woodlands can be improved by the elimination of grazing, removal of undesirable trees, and replanting poorly stocked stands.

The foundations and footings of buildings constructed on this soil should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Excavations can be difficult in some areas because of the underlying bedrock, and large machinery may be required. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. In some areas the underlying bedrock hinders the installation of distribution lines for septic tank absorption fields. The design and placement of the absorption field should be confined to those areas where the bedrock is sufficiently deep.

This soil is in capability subclass IIe.

476C2—Frankville silt loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is on the summits of narrow ridges and mesalike hills. Slopes are long and smooth and mostly convex. Areas are mainly long and narrow and range from 3 to about 10 acres.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is about 47 inches thick. The upper 26 inches is dark brown, dark yellowish brown, and yellowish brown, friable silt loam and silty clay loam; the middle part is dark brown, firm clay; and the lower part to a depth of about 56 inches is dark brown very flaggy clay. The underlying material is fractured limestone. In places the surface layer is black or very dark brown to a depth of 10 inches or more. The silty surface layer and upper part of the subsoil have a combined thickness of less than 18 inches or more than 36 inches in places. Some areas that have strongly convex slopes have a dark brown surface that is a mixture of the surface layer and subsoil. These soils are lower in content of organic matter and are less friable. In some areas where slopes are strongly convex, the silty layer is thin and as much as 20 percent of the surface is covered with limestone fragments. Some small areas have a thin layer of shale in the lower part of the soil.

Included with this soil in mapping are small areas of well drained and moderately well drained Massbach soils, somewhat poorly drained Shullsburg soils, and well

drained Mt. Carroll soils. The Massbach and Shullsburg soils are underlain by shale and have plane slopes. They make up 2 to 5 percent of mapped areas. The Mt. Carroll soils are silty throughout and mostly have slightly concave slopes. They make up 1 to 5 percent of mapped areas.

Water and air move through the surface layer and upper part of the subsoil at a moderate rate and through the lower part of the subsoil at a slow rate. The available water capacity is moderate. Surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is low or medium. The surface layer and subsoil are neutral through medium acid. The content of organic matter in the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. Roots develop easily in the silty layers, but root growth is slowed by the clayey subsoil at a depth of 18 to 36 inches. This soil warms and dries early in the growing season. It is moderately easy to till. The range in soil moisture suitable for tillage is moderately wide. Because the surface layer is high in content of silt, the soil is easily eroded. Also, the surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces intake of air and water.

Most areas of this soil are used for cropland. Some areas are used for pasture. Corn, alfalfa-grass forage, and small grain are the main crops grown. Suitability is poor for row crops, such as corn. The major limitations are the hazard of erosion and the moderate available water capacity. Corn suffers from drought unless rainfall is timely throughout the growing season. Plant populations, varieties, and fertilizer rates need to be adjusted to the limited moisture supply. The hazard of erosion is severe because of the long, moderate slopes and easily erodible soil. Due to the limited depth of productive soil, further soil loss is critical. Erosion can be controlled by including forage crops in a combination with row crops in the cropping system. Growing forage crops and corn in alternating strips on the contour is well suited to the long, smooth slopes. Tillage methods that leave large amounts of crop residue on the surface are well suited to this soil because the soil warms and dries early in spring. Terraces are generally not well suited to this soil because of limited thickness of the silty layer. Cuts needed for terrace construction can expose the bedrock or clayey subsoil, lowering crop yields.

This soil has fair suitability for forage and pasture crops. Hay and pasture production is low during the summer because of insufficient moisture. Suitable plant varieties, having a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage. Forage and pasture crops respond well to fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and production can be increased by planting to more productive species, such as alfalfa or bromegrass. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Some areas of this soil are in woodland. Trees are well suited to this soil. Most woodlands could be improved by elimination of grazing, removal of undesirable trees, and replanting poorly stocked stands. New plantings need protection from plant competition. This can be done by careful spraying with herbicides or by cultivating.

The foundations and footings of buildings constructed on this soil should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Excavations can be difficult in some areas because of the underlying bedrock, and large machinery may be required. Sites should be designed to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. In some areas the underlying bedrock hinders the installation of distribution lines for septic tank absorption fields. The design and placement of the absorption field should be confined to those areas where the bedrock is sufficiently deep.

This soil is in capability subclass IIIe.

476D—Frankville silt loam, 12 to 20 percent slopes. This well drained, moderately steep soil is on tops of narrow ridges and low mesalike hills. Slopes are long and smooth and mostly convex. Areas are long and narrow and range from 3 to about 10 acres.

Typically, the surface layer is very dark brown silt loam about 4 inches thick. The subsurface layer is friable, dark grayish brown silt loam about 7 inches thick. The subsoil is about 49 inches thick. The upper part is dark brown, dark yellowish brown, and yellowish brown, friable silt loam; the middle part is light olive brown, firm clay; and the lower part is light olive brown flaggy and very flaggy clay. Where the surface layer has been tilled, it is very dark grayish brown silt loam about 6 to 9 inches thick. Strongly convex cultivated areas have a brown surface layer that is a mixture of surface soil and subsoil. Small areas have a thin shale layer in the lower part of the subsoil. In a few places the silty surface and upper part of the subsoil have a combined thickness of less than 18 inches or more than 36 inches. As much as 20 percent of the surface is covered with limestone fragments in places where the silty layer is thin.

Included with this soil in mapping are small areas of well drained Mt. Carroll soils. The Mt. Carroll soils formed in deep silty material and have plane and

concave slopes. They make up 1 to 3 percent of mapped areas.

Water and air move through the surface soil and upper part of the subsoil at a moderate rate and through the lower part of the subsoil at a slow rate. Surface runoff is rapid, and the available water capacity is moderate. In the subsoil the availability of phosphorus is high and potassium is low or medium. The content of organic matter in the surface layer is moderate. The surface soil and subsoil are neutral through medium acid. The water table is below a depth of 6 feet in all seasons. The rooting zone is restricted by the clayey subsoil at a depth of 18 to 36 inches. This soil warms and dries early in the growing season. It is moderately easy to till. The range in soil moisture suitable for tillage is moderately wide. Because the surface layer is high in content of silt, the soil is easily eroded. Also, the surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces intake of air and water.

Most areas of this soil are used for pasture. Some areas are used for cropland or are in woodland. This soil is poorly suited to row crops. The main limitations are the hazard of erosion and the moderate available water capacity. Row crops, such as corn, suffer from drought in most years unless rainfall distribution is timely. Small grain is well suited because it can take better advantage of the available moisture early in the growing season. The hazard of erosion is severe because of the long, strong slopes and easily erodible soil. Because the productive silty layer is thin, further erosion is critical.

This soil has fair suitability for forage and pasture crops. Hay and pasture production is low during summer because of insufficient moisture. Planting suitable varieties, having a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and pasture yields can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Some areas of this soil are in woodland, mainly native hardwoods. Trees are well suited to this soil. Pruning and thinning trees increase their quality and rate of growth. Areas that are poorly stocked can be cleared and replanted with desired trees or allowed to regenerate naturally. The application of herbicides helps to suppress competition in new plantings.

This soil is poorly suited to use as building sites because of slope and the depth to bedrock. Extensive land shaping and blasting of bedrock are generally necessary. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. The roads should be constructed on the contour, where possible, and roadbanks need to be planted to well adapted grasses to minimize the erosion hazard. This soil is poorly suited to use as septic tank absorption fields because of the underlying bedrock and steepness of slope. Land shaping and installing the distribution lines across the slope are generally necessary for proper operation. The bedrock hinders the installation operations in many areas.

This soil is in capability subclass IVe.

477—Littleton silt loam. This somewhat poorly drained, nearly level soil is on broad stream terraces typically below foot slopes. Slopes are slightly concave or plane. Areas are mainly elongated and range from 5 to about 20 acres.

Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is black silt loam about 32 inches thick. The subsoil is brown and grayish brown, mottled silty clay loam to a depth of about 60 inches. The subsurface layer is less than 24 inches thick in places. A few places are underlain by sand below a depth of 40 inches. Some areas are moderately well drained.

Included with this soil in mapping are small areas of well drained and moderately well drained Eitzen soils and poorly drained Walford Variant soils. The Eitzen soils are near the floodway and make up 1 to 5 percent of mapped areas. The Walford Variant soils are on lower positions and make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. The availability of phosphorus and potassium in the subsoil is medium. The content of organic matter in the surface layer is moderate. The surface layer is neutral or slightly acid, and the subsoil is slightly acid or medium acid. The rooting zone extends to a depth of more than 48 inches. The water table is at a depth of 2 to 4 feet during wet seasons. This soil warms and dries somewhat slowly in spring. It is moderately easy to till. The range in soil moisture suitable for tillage is moderately wide.

Areas of this soil are used mainly for cropland. They are well suited to this use. Row crops, such as corn, can be grown satisfactorily every year if fertility is maintained and weeds, diseases, and insects are controlled. This soil is less suited to small grain than to some other crops because the very high available water capacity causes the small grain to lodge. In a few places overflow and sediment can damage crops. Natural waterways need to be deepened and widened in places and maintained as grassed waterways to channel runoff safely. This soil becomes compacted and cloddy if worked when too wet. Tilling the soil within the suitable

range of soil moisture and keeping tillage to a minimum help maintain a friable surface soil. Returning large amounts of crop residue and applying manure help maintain a friable surface and improve fertility.

This soil is poorly suited to use as building sites because of wetness. Buildings with basements should not be constructed on this soil. Landscaping should be designed to drain surface water away from foundations. Tile drains around foundations help remove excess subsurface water. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table. In places a mound-type absorption field is needed.

This soil is in capability class I.

484D—Eyota sandy loam, 12 to 20 percent slopes. This well drained, moderately steep to steep soil is on foot slopes below very steep sides of narrow ridges and mesalike hills. Areas are long and narrow and tend to wind around the base of ridges and hills. They range from 3 to about 30 acres.

Typically, the surface layer is black sandy loam about 33 inches thick. The subsurface layer is very dark brown sandy loam about 5 inches thick. The subsoil is about 22 inches thick. The upper part is brown loam about 5 inches thick, and the lower part to a depth of 60 inches is dark yellowish brown silt loam. The surface soil is loamy sand as much as 20 inches thick in places. The surface soil and subsoil are loam in places. The lower part of the subsoil and underlying material in a few places are sandy loam or loam and have olive gray and grayish brown sandstone fragments. Small areas are underlain by sandstone bedrock at a depth of less than 60 inches.

Included with this soil in mapping are well drained Lindstrom soils and somewhat excessively drained Plainfield Variant soils. The Lindstrom soils are silty, and the Plainfield Variant soils formed in a mantle of sand. The included soils are on positions similar to those of this Eyota soil. The Lindstrom soils make up 2 to 5 percent of mapped areas, and the Plainfield Variant soils make up 1 to 5 percent.

Water and air move through this soil at a moderately rapid rate. The available water capacity is moderate, and surface runoff is medium. In the subsoil the availability of phosphorus is medium and potassium is low. The surface layer is slightly acid or medium acid, and the lower part of the solum is medium acid through very strongly acid. The content of organic matter in the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of more than 60 inches. This soil warms and dries early in the growing season. It is easy to till. The range in soil moisture suitable for tillage is wide.

Most areas of this soil are used for cropland. Some areas are used for pasture. Corn, alfalfa-grass forage, and small grain are the main crops. Row crops are poorly suited. The main limitation is the erosion hazard, but in years that have below normal rainfall distribution, lack of moisture is also limiting. Erosion can be controlled if row crops are grown only occasionally and in combination by hay crops. This soil is well suited to growing forage crops and corn in alternating strips on the contour. Tillage methods that leave large amounts of crop residue on the surface in combination with applications of manure help reduce erosion. Gullies develop easily in this soil. Gullies can be prevented by shaping, seeding, and maintaining drainageways as grassed waterways.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass. Production of bluegrass is moderate because of the moderate available water capacity. Yields can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Trees are well suited to this soil, but areas are not generally used for woodland. Where new plantings are started, competing vegetation needs to be controlled to allow for good growth. Scalping or furrowing the site before planting helps to control plant competition. Herbicides can be used effectively on many sites. Thinning and pruning of stands increase their value and quality.

Slope is the main limitation of this soil for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed for road construction. Roads should be placed on the contour, and roadbanks need to be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IVe.

488G—Brodale cobbly fine sandy loam, rocky, 45 to 70 percent slopes. This excessively drained, very steep soil is on the sides of ridges along stream valleys. Slopes are mostly convex. They are typically south and west facing. Gullies dissect this soil in most places. Outcroppings of rock are common on nose positions and near the top of slopes. Typically, 10 to 50 percent of the surface is covered with cobbles. Areas are elongated and range from 10 to several hundred acres (fig. 10).

Typically, the surface layer is very dark gray cobbly fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown very cobbly loam about 5 inches thick. The underlying material is dark brown, olive brown, and light olive brown very cobbly loam to a depth of 60 inches. In places the bedrock is at a depth of less than 40 inches. Lime is leached to a depth of more than 15 inches in places.

Included with this soil in mapping are small areas of excessively drained Boone soils, well drained Elbaville and Lamoille soils, and outcrops of rock. The Boone soils are sandy and are on the most strongly convex parts of the slope. The Elbaville soils contain more clay than this Brodale soil and are on foot slopes. The Lamoille soils have a clayey subsoil and are in the less sloping positions. The included soils each make up about

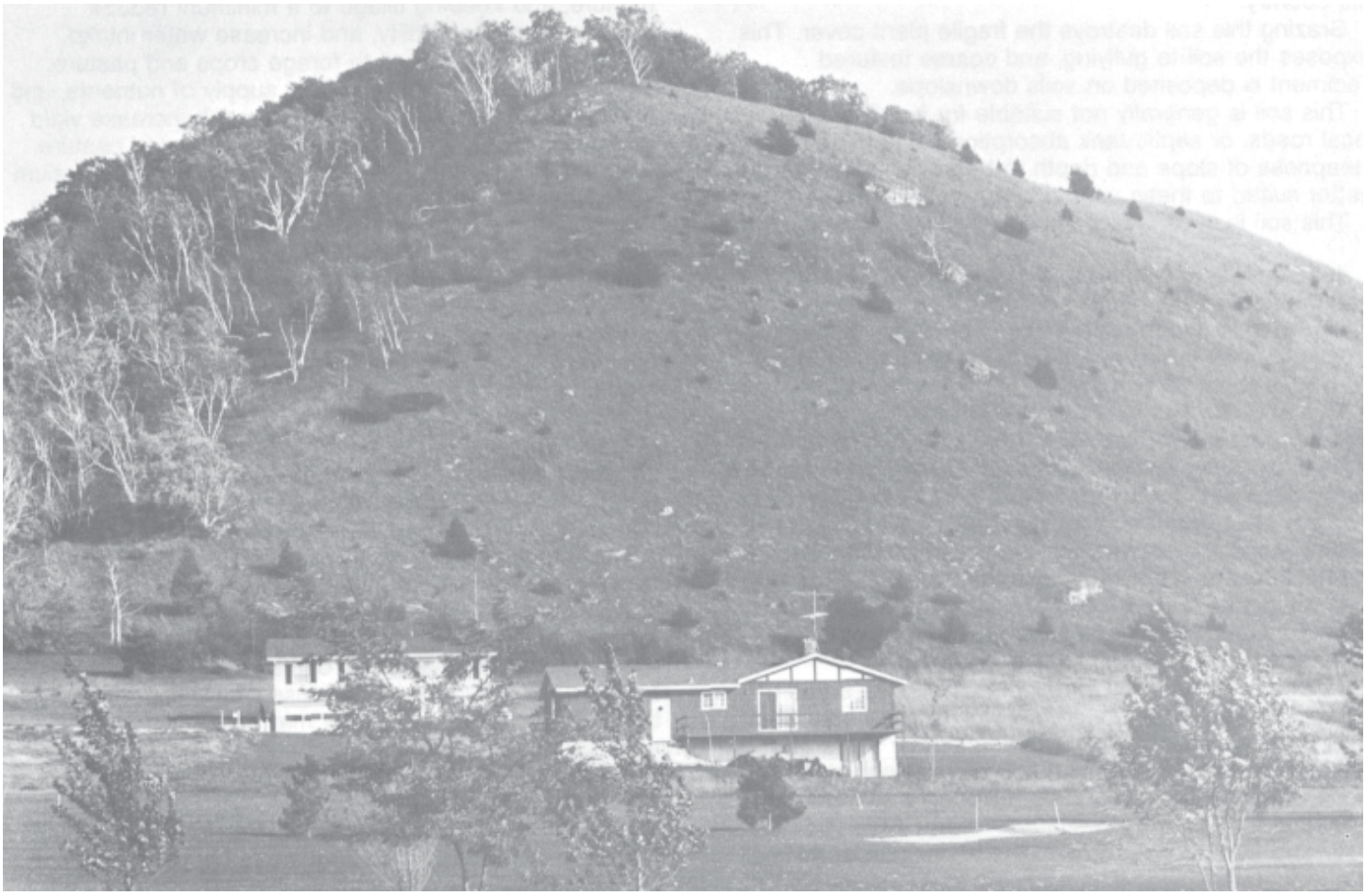

Figure 10.—An area of Brodale cobbly fine sandy loam, rocky, 45 to 70 percent slopes. Outcrops are Jordan sandstone. Vegetation is mainly bunch grasses, cedar, and stunted birch.

1 to 5 percent of mapped areas. The outcrops consist mostly of sandstone, but some are limestone. They make up 1 to 10 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is low, and surface runoff is very rapid. The availability of phosphorus is low and potassium is medium. The surface layer is neutral or mildly alkaline, and the subsoil is mildly alkaline or moderately alkaline. The organic matter content of the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. Plant roots grow with difficulty below a depth of 10 to 20 inches because of the large amount of cobbles.

Most areas of this soil are in native grasses and other prairie plants or in brush and thin stands of stunted oak. Some areas are used for pasture. This soil is poorly suited to cropland, hay crops, pasture, and woodland. Limitations are severe because of the very steep slopes, low available water capacity, and warm exposures. This soil is unique in that it supports some of the last remaining stands of native prairie grasses in this part of the country.

Grazing this soil destroys the fragile plant cover. This exposes the soil to gullying, and coarse textured sediment is deposited on soils downslope.

This soil is generally not suitable for building sites, local roads, or septic tank absorption fields because of steepness of slope and depth to bedrock. Soils that are better suited to these uses are generally nearby.

This soil is in capability subclass VIIs.

492B—Nasset silt loam, 3 to 6 percent slopes. This well drained, gently sloping soil is on the crests of narrow ridges and mesalike hills in uplands. Slopes are mostly convex. Areas are irregular in shape and range from 5 to about 20 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The upper 37 inches of the subsoil is brown, dark yellowish brown, and yellowish brown silt loam, the next 9 inches is reddish brown, very firm silty clay, and the lower part to a depth of about 60 inches is reddish brown very flaggy silty clay. In places the thickness of silt loam is less than 36 inches or more than 45 inches. Some areas are moderately well drained. In some areas the surface layer is eroded. Depth to limestone is less than 60 inches in places.

Included with this soil in mapping are small areas of the well drained and moderately well drained Massbach soils. The Massbach soils are underlain by shale at a depth of 30 to 50 inches and are on positions similar to those of this Nasset soil. They make up 2 to 5 percent of mapped areas.

Air and water move through the upper part of this soil at a moderate rate and through the lower clayey part at a slow rate. Surface runoff is medium. The available water capacity is high. The content of organic matter in the surface layer is moderate. The subsoil is neutral through strongly acid in the upper part and neutral or mildly alkaline in the lower part. In the subsoil the availability of phosphorus is high and potassium is low or medium. The water table is below a depth of 6 feet in all seasons. The rooting zone is restricted by the limestone fragments at a depth of 40 to 55 inches. This soil warms early in spring and is moderately easy to till. This soil is easily eroded. The surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces intake of air and water.

Most areas of this soil are used for cropland. A few areas are used for pasture. Corn, alfalfa-grass forage, and small grain are the crops commonly grown. The main limitation to using this soil for row crops is the hazard of erosion. During years that have below normal rainfall, crops may suffer somewhat from insufficient moisture. Erosion can be controlled by using tillage methods that maintain large amounts of crop residue on the surface or by growing occasional sod-producing crops in the rotation. This soil is well suited to contour tillage. Maintaining crop residue on the surface, applying manure, and keeping tillage to a minimum reduce crusting, improve fertility, and increase water intake.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture. Most areas of pasture are in bluegrass, and many areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

Trees are well suited to this soil, but areas are not generally used for woodland. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

The foundations and footings of buildings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Excavations can be difficult in some areas because of the underlying bedrock, and large machinery may be required. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. In some areas the underlying bedrock in this soil hinders the installing of distribution lines for septic tank absorption fields. The design and placement of the absorption field may be confined to those areas where the bedrock is sufficiently deep.

This soil is in capability subclass IIe.

492C—Nasset silt loam, 6 to 12 percent slopes. This well drained, sloping soil is on the summits of narrow ridges and mesalike hills in uplands. Slopes are convex to concave. Areas are irregular in shape and range from 5 to about 15 acres.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The upper 39 inches of the subsoil is brown and dark yellowish brown, friable silt loam, the next 5 inches is reddish brown, firm clay, and the lower part to a depth of 60 inches is reddish brown, very flaggy clay and fractured limestone that has clay fillings in the fractures. In some areas the surface layer has been mixed with material from the subsoil because of erosion. In places the thickness of silt loam is less than 36 inches or more than 45 inches. In a few places the dark colored surface layer is more than 10 inches thick. Hard limestone bedrock is at depth of less than 60 inches in some areas.

Included with this soil in mapping are areas of the well drained and moderately well drained Massbach soils and well drained Edmund soils. The included soils are on positions similar to those of this Nasset soil. The Massbach soils are underlain by shale at a depth of 30 to 50 inches. They make up 2 to 5 percent of mapped areas. The Edmund soils are shallower to limestone than Nasset soils. They make up less than 5 percent of mapped areas.

Air and water move through the upper part of this soil at a moderate rate and through the lower clayey part at a moderately slow rate. Surface runoff is medium. The available water capacity is high. The content of organic matter in the surface layer is moderate. The upper part of the solum is neutral through strongly acid, and the lower part is neutral or mildly alkaline. In the subsoil the availability of phosphorus is high and potassium is low or medium. The water table is below a depth of 6 feet in all seasons. The rooting zone is restricted by limestone fragments at a depth of 40 to 55 inches. This soil warms and dries early in the growing season. It is moderately easy to till. This soil is easily eroded. The surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces intake of air and water.

Most areas of this soil are used for cropland. Alfalfa-grass forage, small grain, and corn are the commonly grown crops. Suitability is fair for row crops, such as corn. The hazard of erosion is the main limitation to using this soil for row crops. During years in which rainfall is below normal, crops may suffer somewhat from insufficient moisture. Row crops can be grown and erosion controlled if corn is grown in rotation with forage crops. Using a combination of forage crops and tillage methods that leave large amounts of crop residue on the surface is well suited to controlling erosion. Growing forage crops and corn in alternating strips on the contour is well suited because of the long, smooth slopes. Terraces are suited in most places, but special investigations are needed to insure that construction will not expose the clayey subsoil. Leaving crop residue on the surface, growing forage crops in the rotation, and applying manure increase intake of moisture, increase fertility, and reduce crusting in addition to controlling erosion. Drainageways crossing this soil develop gullies easily. Gully erosion can be controlled by shaping, seeding, and maintaining drainageways as grassed waterways.

This soil is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this soil are used for pasture, and most of these are in bluegrass. The pasture in many areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

Trees are well suited to this soil, but areas are not generally used for woodland. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

The foundations and footings of buildings constructed on this soil should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Excavation can be difficult in some areas because of the underlying bedrock, and large machinery may be required. Sites should be designed to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields. The bedrock hinders installation operations in some areas.

This soil is in capability subclass IIIe.

500C2—Edmund silt loam, 4 to 12 percent slopes, eroded. This well drained, gently sloping to sloping soil is on narrow ridges and mesalike hills. Slopes are convex. Areas are long and narrow and range from 3 to about 10 acres.

Typically, the surface layer is dark brown silt loam about 9 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, very friable silt loam,

and the lower part is dark brown, firm silty clay grading to dark brown very flaggy silty clay. The underlying material is hard limestone bedrock. Most areas in pasture and woodland have not been eroded. In places on plane and slightly concave positions, the silty layer is more than 20 inches thick.

Included with this soil in mapping are somewhat poorly drained Shullsburg soils. The Shullsburg soils are underlain by shale. They typically have plane slopes and make up 2 to 10 percent of mapped areas.

Water and air move through this soil at a moderately slow rate. Surface runoff is medium. The available water capacity is low. The availablity of phosphorus and potassium in the subsoil is medium. The subsoil is medium acid to neutral. The content of organic matter in the surface layer is moderate. Roots grow easily in the silty layers, but growth is slowed in the clayey subsoil. The water table is below a depth of 6 feet in all seasons. This soil is easy to till except in the areas where the surface layer is silty clay loam or flaggy silty clay loam. These areas dry slowly after rains and are difficult to till and maintain in a friable condition.

Areas of this soil are used for cropland and pasture. A few scattered tracts are in woodland. Alfalfa-grass forage, corn, and small grain are the common crops. Most areas of this soil are small and therefore managed with the dominant nearby soils. This soil is poorly suited to row crops. The main limitations are the moderate to severe hazard of erosion, the low available water capacity, and the limited rooting depth. Yields of corn are low unless rainfall is timely throughout the growing season. Small grain is better suited than some other crops because it can make better use of the available moisture in the early part of the growing season. Soil loss is critical because of the limited soil depth. To control erosion, row crops such as corn should be grown only occasionally and in combination with forage crops. In most places growing forage crops and corn in alternating strips on the contour is well suited to this soil. Returning crop residue, using minimum tillage methods that leave large amounts of crop residue on the surface, and applying manure further reduce soil loss and improve fertility.

This soil has fair suitability for forage and pasture crops. Hay and pasture production is low during summer because of insufficient moisture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and pasture yields can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Areas of this soil are not generally used for woodland, but some trees grow well on this soil. Trees that tolerate the low moisture supply, such as pine, are better suited than many other species.

The foundations and footings of buildings constructed on this soil should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Excavations are difficult in some areas because of the underlying bedrock, and large machinery may be required. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the depth to bedrock. In places the bedrock hinders the installing of distribution lines.

This soil is in capability subclass IVe.

500D2—Edmund silt loam, 12 to 20 percent slopes, eroded. This well drained soil is on narrow ridges and mesalike hills. Slopes are mostly convex. Areas are long and narrow and range from 3 to about 10 acres.

Typically, the surface layer is very dark brown silt loam about 7 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is about 31 inches thick. The upper part is very dark grayish brown silty clay loam and reddish brown silty clay, and the lower part is channery and flaggy silty clay grading to reddish brown very flaggy silty clay. Most areas in pasture and woodland have not been eroded. In places the underlying bedrock is below a depth of 60 inches. In some areas the silty layer is more than 20 inches thick. On strongly convex slopes in places that have been eroded, the surface layer is a very dark brown channery silty clay loam mixture of surface soil and subsoil. In these places the surface layer is low in organic matter and difficult to till and maintain in a friable condition.

Included with this soil in mapping are small areas of somewhat poorly drained Shullsburg soils. The Shullsburg soils are underlain by shale. They are on positions similar to those of this Edmund soil and make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderately slow rate. Surface runoff is rapid. The available water capacity is low. In the subsoil the availability of phosphorus is medium and potassium is low. The subsoil is medium acid through mildly alkaline. The organic matter content of the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 36 inches or more, depending on the depth to bedrock. This soil warms and dries early in the growing season. It is moderately easy

to till. The range in soil moisture suitable for tillage is moderately wide.

Most areas of this soil are used for pasture. Suitability is fair for pasture and forage crops. Row crops are poorly suited because of the shallow rooting depth, steepness of slope, and low available water capacity. This soil is better suited to pasture and forage crops than to most other crops. Insufficient moisture during the warm summer and the shallow rooting depth are the main limitations for hay and pasture crops. Deep-rooted species take better advantage of the limited moisture supply than the bluegrass in most areas. Planting suitable varieties, having a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

This soil is not generally used for woodland, and it is poorly suited to trees. Trees that tolerate the low moisture supply, such as pine, are better suited than many other species.

The foundations and footings of buildings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Excavations are difficult in some areas because of the underlying bedrock, and large machinery may be required. Sites should be designed to conform to the natural slope of the land. This soil is poorly suited to road construction because of slope and low soil strength and because damage may result from shrinking and swelling of the soil. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Placing roads on the contour whenever possible and planting roadbanks to well adapted grasses help to minimize the erosion hazard. Large amounts of cutting and filling are required in some areas. This soil is poorly suited to use as septic tank absorption fields because of the underlying bedrock and steepness of slope. Land shaping and installing the distribution lines across the slope are generally necessary for proper operation. The bedrock hinders the installation operations in many areas.

This soil is in capability subclass VIe.

518—Kalmarville silty clay loam, occasionally flooded. This poorly drained, level soil is near the former channel of the Root River. This soil is subject to occasional flooding. Shallow drainageways cross areas of this soil in many places. Areas are irregular in shape and range from 5 to about 40 acres.

Typically, the surface layer is very dark gray silty clay loam about 10 inches thick. The subsurface layer is about 17 inches thick. The upper part is black, mottled loam, and the lower part is very dark gray, mottled, calcareous fine sandy loam. The underlying material to a depth of about 60 inches is stratified, mottled, gray sand and loamy fine sand and dark gray fine sandy loam. In a few places the very dark gray surface layer is as much as 25 inches thick. The surface layer is loamy sand in a few places. A few small areas are somewhat poorly drained or are very poorly drained.

Included with this soil in mapping are small areas of the poorly drained Comfrey and Moundprairie soils. The included soils are on positions similar to those of this Kalmarville soil. The Comfrey soils contain more clay, and the Moundprairie soils are silty throughout. These soils make up 5 to 10 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. The available water capacity is moderate. Surface runoff is slow. The availability of phosphorus and potassium in the underlying material is medium. The content of organic matter in the surface layer is moderate to high. The upper part of the soil is mildly alkaline or neutral, and the lower part is mildly alkaline. The root zone is restricted by the seasonal high water table within a depth of 1 foot during wet seasons. This soil warms and dries slowly in spring. The range of soil moisture suitable for tillage is moderately wide; within this range tillage is moderately easy to moderately difficult.

Most areas of this soil are used for cropland. Some areas are used for pasture. This soil is poorly suited to row crops, such as corn and soybeans. The main limitations to use are flooding, early season wetness, and drought in summer. In places crop damage from flooding has been reduced or overcome by use of dikes. Spring planting in many years is delayed by slow warming and drying of the soil. Many areas are too low to drain with tile, but shallow ditches can be used in places to help remove surface water. In years that have a wet spring, soybeans are better suited than corn because they are generally planted later. This soil is commonly wet in spring, and moisture is abundant or in excess because of the shallow water table. During the dry summer, however, the water table is deep and moisture is commonly insufficient when the crop needs are greatest. Unless rainfall is well distributed in summer, crops may suffer from drought because of the moderate available water capacity. Plant populations, plant varieties, and fertilizer rates should be adjusted to the somewhat limited moisture supply.

This soil is well suited to early season pasture, but in years that have poor distribution of rainfall, pasture production in summer is lowered because of insufficient moisture. Legumes are generally not well adapted to this soil because of soil wetness. Grasses, such as reed canarygrass and Garrison creeping foxtail, are tolerant of wetness and flooding and are better suited than many other species. Pasture can be maintained in a productive condition by good management practices. These include delay of grazing in spring until the soil is firm, proper stocking rates, and rotation of pasture. Maintaining a proper supply of nutrients, clipping mature plants, and controlling weeds improve productivity. Some pasture can be improved by removing brush or trees. This soil is suited to dug ponds.

This soil is not generally used for woodland, although some areas used for pasture have scattered stands of elm, basswood, oak, silver maple, and cottonwood. Species selected for woodland planting must be tolerant of wetness and flooding. Plant competition from unwanted plants is severe. Vegetation needs to be controlled by careful spraying with herbicides, by clean tillage, or by girdling.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, well compacted, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding, soil wetness, and frost action.

This soil is in capability subclass IIw.

522—Boots mucky peat. This very poorly drained, level soil is in large depressions on flood plains and on low terraces. This soil is subject to occasional flooding. Because of its low position on the landscape, it is subject to overflow from soils at higher elevations. Areas are irregular in shape and range from 10 to 40 acres or more.

Typically, the surface layer is very dark brown mucky peat to a depth of about 22 inches. The next layer to a depth of about 60 inches is dark brown mucky peat. Small areas have a layer of very dark gray silt loam or silty clay loam as much as 20 inches thick overlying the muck. In places loamy or silty mineral soil is below the peat within a depth of 51 inches. In places the soil is black muck.

Included with this soil in mapping are small areas of poorly drained Walford and Newalbin soils. The Walford and Newalbin soils are silty. They are on higher positions than this Boots soil and make up 2 to 10 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate if the water table is lowered. The available water capacity is very high. Surface runoff is very slow, and the soil is commonly ponded most or all of the growing season. The availability of phosphorus and potassium is very low. The soil is neutral throughout, and the content of organic matter is very high. The water table is within a depth of 1 foot most of the year. The rooting zone is restricted by the depth to the water table.

Most areas of this soil support a native growth of reeds, sedges, and cattails. A few areas are in pasture, but forage quality is poor.

This soil is well suited to providing food and cover for wetland wildlife. Ponds can be built where the organic layer is thin, but side slopes of the pond are subject to cave-in during flooding.

This soil is generally not suitable for building sites because of the flooding hazard and because of structural damage that can result because of low soil strength. It is generally not suitable for septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, well compacted fill material and providing adequate side ditches and culverts help protect the roads from flood and frost damage.

This soil is in capability subclass VIw.

576—Newalbin silt loam. This poorly drained, nearly level soil is in narrow valleys. It is subject to occasional flooding in spring and early in summer. Areas are irregular in shape and range from 3 to about 15 acres.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The underlying material to a depth of about 60 inches is mottled, dark gray, stratified silt loam and light brownish gray very fine sand. A buried soil is below the underlying material and extends to a depth of about 60 inches. It is typically black fine sandy loam. A few small areas are underlain by muck at a depth of 30 to 60 inches.

Included with this soil in mapping are small areas of poorly drained Root soils and a moderately well drained sandy soil. The Root soils have a cobbly subsoil and are adjacent to the streambed. The sandy soil lies next to natural levees of the stream. The included soils each make up 1 to 2 percent of mapped areas.

Air and water move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is slow. In the underlying material the availability of phosphorus is high and potassium is low or medium. The surface layer and underlying material are neutral or slightly acid. The content of organic matter in the surface layer is moderately low. The seasonal high water table is at a depth of 1 foot to 3 feet. The rooting zone is restricted by the water table. This soil warms and dries slowly in spring. It is moderately easy to till if the soil moisture content is within the range suitable for tillage. The surface layer tends to puddle during rains. Upon drying it forms a crust that reduces intake of air and water.

Most areas of this soil are used for cropland or pasture. Wetness and flooding limit the use of this soil

for cropland. Where the soil can be properly drained, corn, soybeans, small grain, and forage crops are well suited. Successful drainage depends on adequate outlets that may not be present in places. In most places the soil is kept wet by underground flow from higher elevations. In some years flooding delays planting. Some areas of this soil are protected from flooding by dams. A more friable surface layer can be maintained by returning residue to the soil and applying manure. This soil is fairly easy to till.

Most undrained areas of this soil are used for pasture. They are well suited to pasture. Because the water table is near the surface much of the year, bluegrass pasture, if well managed, remains productive through the warm, dry summer. Pasture responds well to fertilizer. Lime is not needed for growing legumes. A productive pasture can be maintained by deferment of grazing until the soil firms and plants have reached the proper height for grazing. Some areas of pasture can be improved by removing the brush. Controlling weeds and clipping mature plants increase pasture productivity. Rotating pasture and using proper rates of stocking utilize forage efficiently and maintain the sod in good condition.

This soil has poor suitability for trees. Plant competition, seedling mortality, and windthrow hazard are detrimental to establishing good stands. The high water table causes poor root development and restricts depth of rooting. Plant competition can be controlled by tilling or careful spraying with herbicides. Suitable trees to plant are willow, soft maples, or northern white-cedar.

This soil is generally not suitable for building sites and septic tank absorption fields because of the flooding hazard and seasonal high water table. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, well compacted fill material and providing adequate side ditches and culverts help protect the roads from flooding and frost damage.

This soil is in capability subclass IIw.

577—Newalbin silt loam, channeled. This poorly drained, nearly level soil is in narrow valleys. It is subject to occasional flooding in spring and early in summer. Meandered stream channels have dissected areas into many small irregular-shaped tracts. Areas range from 3 to about 40 acres.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The underlying material to a depth of 57 inches is dark gray, mottled silt loam and has very thin strata of light brownish gray and grayish brown very fine sand. Below this is a black fine sandy loam buried soil. In some areas the silty overwash layer is thinner. In small areas the surface layer has thin layers of fine sandy loam.

Included with this soil in mapping are small areas of poorly drained Root soils and a somewhat poorly drained to moderately well drained sandy soil. Also included are a few small areas underlain by muck at a depth of 30 to 60 inches. The Root soils are cobbly in the subsoil. They are adjacent to the streambed and make up about 1 to 5 percent of mapped areas. The sandy soils are near the stream channel on the natural levees. They make up 1 to 2 percent of mapped areas. The soils underlain by muck are in slight depressions and make up 1 to 2 percent of mapped areas.

Air and water move through this soil at a moderately slow rate. The available water capacity is very high. Surface runoff is slow. The underlying material is high in available phosphorus and medium in available potassium. The surface layer and underlying material are neutral or slightly acid. The content of organic matter in the surface layer is moderately low. The water table is at a depth of 1 foot to 3 feet during wet seasons. The rooting zone is restrictd by the water table.

Most areas of this soil are used for bluegrass pasture because it is too wet and the areas that can be cropped are too small to crop efficiently (fig. 11). Most places are difficult to renovate for pasture because deep channels limit accessibility by farm machinery. This soil is well suited to bluegrass because the water table near the surface provides moisture during summer. Pasture can be maintained in good condition by deferment of grazing until the soil firms and plants are at the proper grazing height. Proper stocking rates and rotation of pasture improve utilization of forage and maintain the sod in good condition. Removal of brush and trees improves pasture in places. Pasture fences are difficult to maintain because of flooding.

This soil has poor suitability for trees. Plant competition and seedling mortality are detrimental to good tree stands. The high water table causes poor root development and restricts depth of rooting. Plant competition can be reduced by weed control and removing undesirable species. Trees better suited to the wet conditions than some other species are willows, soft maples, and northern white-cedar.

This soil is generally not suitable for building sites and septic tank absorption fields because of the flooding hazard and seasonal high water table. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, well compacted fill material and providing adequate side ditches and culverts help protect the roads from flooding and frost damage.

This soil is in capability subclass Vw.

Figure 11.—An area of nearly level Newalbin silt loam, channeled, in pasture near Winnebago Creek. Timula soils are on the slopes bordering the flood plain.

578—Newalbin silt loam, depressional. This very poorly drained, nearly level soil is in drainageways and depressions that were formerly stream channels within narrow valleys. Most areas occur next to steep terrace side slopes. This soil is subject to occasional flooding during spring and early in summer. Springs flow from a few areas. In places water remains ponded for about 6 months during the year. Areas of this unit are irregular in shape and range from 3 to about 15 acres.

Typically, the surface layer is dark gray silt loam about 11 inches thick. The underlying material is dark gray, mottled silt loam about 32 inches thick. Below this is a buried soil about 20 inches thick. The upper part is black silt loam, and the lower part is black silty clay loam. The buried subsoil to a depth of about 60 inches is gray silt loam. In a few places the buried soil consists of muck. In a few areas the surface layer is sandy loam.

Included with this soil in mapping are small areas of very poorly drained Palms and Root soils. The Palms soils developed in organic soil material. They are on positions similar to those of this Newalbin soil and make up 1 to 3 percent of mapped areas. The Root soils are cobbly in the subsoil. They are adjacent to the streambed and make up 1 to 4 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is very slow or ponded. The availability of phosphorus in the underlying material is high and potassium is medium. The subsoil is neutral or slightly acid. The content of organic matter in the surface layer is moderately low. The seasonal high water table is at the surface or within a depth of 2 feet during most of the year. The rooting zone is restricted to a shallow depth because of the shallow water table.

Most areas are in pasture, which is mainly sedges and other unproductive and unpalatable species. This soil is poorly suited to cropland, pasture, and woodland.

Wetness and flooding are the main limitations. Water-tolerant species, such as reed canarygrass and meadow foxtail, provide higher quality forage if they can be established. Controlling the number of livestock and rotation of pasture utilize forage more efficiently and maintain the sod in good condition. Fences are difficult to maintain because of the flooding hazard.

This soil is generally not suitable for building sites and septic tank absorption fields because of the flooding and ponding hazards. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding and ponding.

This soil is in capability subclass VIIw.

580B—Blackhammer-Southridge silt loams, 3 to 6 percent slopes. This map unit consists of well drained soils on gently sloping crests of ridges. Slopes are long, smooth, and are mostly convex. Areas are irregular in shape and range from 3 to about 30 acres. They are about 25 to 55 percent Blackhammer soils and 25 to 35 percent Southridge soils. The Blackhammer and Southridge soils are on similar positions. Individual areas of these soils are so small or intricately intermingled that to separate them in mapping was not practical.

Typically, the surface layer of a Blackhammer soil is very dark grayish brown silt loam with a few patches of dark brown subsoil material and is about 7 inches thick. The subsoil is about 53 inches thick. The upper 22 inches is brown and dark yellowish brown, friable silt loam. The lower part is strong brown, reddish brown, and yellowish red, stratified clay loam, sandy loam, sandy clay loam, and loamy sand. Dolomite or sandstone bedrock is within a depth of 5 feet in some areas. The silty layers are less than 20 inches thick or more than 40 inches thick in a few places. The subsoil has layers of olive clay in places.

Typically, the surface layer of a Southridge soil is dark grayish brown silt loam with small patches of brown subsoil material and is about 8 inches thick. The subsoil is about 52 inches thick. The upper 22 inches is brown and yellowish brown silt loam. The lower part is strong brown clay. In a few spots on strongly convex slopes, part of the original surface soil has been eroded. Here, the cultivated layer is a dark brown or brown mixture of the original surface and subsoil. In a few places the loess is less than 15 inches or more than 40 inches thick. Bedrock in a few places is at a depth of less than 5 feet.

Water and air move through the Blackhammer soil and the upper part of the Southridge soil at a moderate rate. Water and air movement is slow in the lower part of the Southridge soil. The available water capacity is moderate or high, and surface runoff is medium for both soils. In both soils the silty upper part of the subsoil is high in available phosphorus and low or medium in potassium. The lower part of the subsoil and the underlying material are low in available phosphorus in both soils. They are low in available potassium in the Blackhammer soil and medium in the Southridge soil. In both soils the subsoil is slightly acid through strongly acid in the upper part and medium acid or strongly acid in the lower part. The content of organic matter in the surface layer of both soils is moderately low. In both soils the water table is below a depth of 6 feet in all seasons. Roots grow easily in the silty layers, but growth is slowed by the lower fertility and the acidity of the more firm underlying loamy and clayey layers at depths of 15 to 40 inches. These soils warm and dry early in the growing season. They are moderately easy to till. The range of soil moisture suitable for tillage is moderately wide. These soils are easily eroded. The surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces the intake of air and water. The surface layer is difficult to maintain in a friable condition.

Most areas of this map unit are used for cropland. Corn, small grain, alfalfa, and grasses are major crops and are well suited. Row crows respond well to lime and fertilizer on these soils. The main limitation is the hazard of erosion. Row crops can be grown satisfactorily nearly every year if erosion is controlled by tillage methods that leave a large amount of crop residue on the surface. This, along with the growing of occasional forage crops and applying manure, reduces crusting, increases intake of water, and helps control erosion. Gullies form easily, and drainageways crossing these soils need to be shaped, seeded, and maintained as grassed waterways to help prevent gully erosion.

This map unit is well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yields and the quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on this map unit. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas are used for pasture. Most areas of pasture are in bluegrass, and the pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

Small areas of this map unit on the ends of narrow ridges are used for woodland. The native oaks grow well on these soils but do not regenerate well where woodland is grazed. New plantings require control of competing vegetation. This can be done by proper tillage or by careful use of herbicides.

The foundations and footings of buildings constructed in this map unit should be designed to prevent structural damage caused by shrinking and swelling of the soils. Backfilling around foundations with suitable coarse material provides added assurance against structural

damage. Constructing roads on well compacted, coarse textured base material helps protect the roads from frost damage. The slow permeability in the lower part of the Southridge soil restricts it from readily absorbing effluent from septic tank absorption fields. Installing a larger than average absorption field helps to overcome this limitation.

This map unit is in capability subclass IIe.

580C2—Blackhammer-Southridge silt loams, 6 to 12 percent slopes, eroded. This map unit consists of well drained, sloping soils on ridgetops. Slopes are long, smooth, and convex. Areas are irregular in shape and range from 3 to about 15 acres. They are about 25 to 55 percent Blackhammer soils and 25 to 35 percent Southridge soils. The Blackhammer and Southridge soils are on similar positions. Individual areas of these soils are so small or intricately intermingled that to separate them in mapping was not practical.

Typically, the surface layer of a Blackhammer soil is dark grayish brown silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper 25 inches is dark yellowish brown and yellowish brown silt loam, and the lower part to a depth of 60 inches is strong brown, reddish brown, reddish yellow, and yellowish red, stratified clay loam, sandy loam, loamy sand, and sandy clay loam. Most areas in pasture and woodland have not been eroded. In a few places the loess thickness is less than 20 inches or more than 40 inches. In small areas the bedrock is at a depth of less than 5 feet. A few small concave areas have a thicker, darker colored surface layer.

Typically, the surface layer of a Southridge soil is dark grayish brown silt loam about 5 inches thick. The subsurface layer is grayish brown, very friable silt loam about 5 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is about 56 inches thick. The upper 14 inches is dark yellowish brown and yellowish brown, friable silt loam, and the lower part is reddish brown, firm clay. Most areas in pasture and woodland have not been eroded. In a few areas the loess thickness is less than 15 inches or more than 40 inches. The bedrock is at a depth of less than 5 feet in places. A few small concave areas have a darker colored surface layer.

Included with these soils in mapping are small areas of well drained silty Chaseburg soils in the drainageways. These soils contain less clay than the major soils. They make up less than 5 percent of mapped areas.

Water and air move through the Blackhammer soil and the upper part of the Southridge soil at a moderate rate. Water and air movement is slow in the lower part of the Southridge soil. The available water capacity is moderate to high, and surface runoff is medium for both soils. In both soils the silty upper part of the subsoil is high in available phosphorus and low or medium in potassium. The lower part of the subsoil and the underlying material are low in available phosphorus in both soils. The available potassium is low in the Blackhammer soil and medium in the Southridge soil. The subsoil in both soils is slightly acid through strongly acid in the upper part and medium acid or strongly acid in the lower part. The content of organic matter in the surface layer of both soils is moderately low. In both soils the water table is below a depth of 6 feet in all seasons. Roots grow easily in the silty layers, but growth is slowed by the lower fertility and the acidity of the more firm underlying loamy and clayey layers at depths of 15 to 40 inches. These soils warm and dry early in the growing season. They are moderately easy to till. The range of soil moisture suitable for tillage is moderately wide. These soils are easily eroded. The surface layer tends to puddle during rains and forms a crust upon drying. The crusting reduces the intake of air and water. The surface layer is difficult to maintain in a friable condition.

Most areas of this map unit are used for cropland. Corn for grain and silage, alfalfa, grasses, and small grain are the main crops. Suitability is fair for row crops, such as corn. Row crops respond well to lime and fertilizer on these soils. The hazard of erosion is the main limitation for row crops. Corn suffers somewhat from drought during long periods of dry weather. Erosion can be controlled and crusting reduced by growing corn in a rotation with forage crops. Growing corn and forage crops in alternating strips on the contour helps control erosion and is well suited to the long, smooth slopes. Tillage methods that leave a large amount of crop residue on the surface are well suited in areas that warm early. These practices, along with applications of manure, increase intake of water and increase fertility. Terraces are not well suited to this map unit because the cutting required for construction can expose the less fertile subsoil that is difficult to till. Drainageways crossing these soils develop easily into gullies. Gully erosion can be reduced by shaping, seeding, and maintaining the drainageways as grassed waterways.

Areas of these soils are well suited to forage crops and pasture. Suitable varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on these soils. Potassium is needed to maintain stands of legumes. A few mostly irregular-shaped areas are used for pasture. Most areas of pasture are in bluegrass, and the pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This map unit is well suited to trees. Some areas are grazed and can be improved by limiting grazing, which

lowers natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for restocking or replanting of preferred trees. Plant competition is severe in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage, careful spraying with herbicides, or girdling.

Buildings constructed on these soils should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soils. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Roads need to be constructed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Constructing roads on well compacted, coarse textured base material helps protect the roads from damage caused by the high clay content in the Southridge soil. These soils are poorly suited to use as septic tank absorption fields because of slope and because of slow permeability in the lower part of the Southridge soil. Installing a larger than average absorption field and placing distribution lines across the slope help to overcome these limitations.

This map unit is in capability subclass IIIe.

580D2—Blackhammer-Southridge silt loams, 12 to 20 percent slopes, eroded. This map unit consists of moderately steep to steep, well drained soils on ridgetops. Slopes are long, smooth, and convex. Areas are elongated and range from 3 to 15 acres. They are about 25 to 50 percent Blackhammer soils and 25 to 40 percent Southridge soils. The Blackhammer and Southridge soils are on similar positions. Individual areas of these soils are so small or intricately intermingled that to separate them in mapping was not practical.

Typically, the surface layer of a Blackhammer soil is dark grayish brown silt loam about 9 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is about 51 inches thick. The upper 20 inches is dark yellowish brown, friable silt loam, and the lower part to a depth of 60 inches is strong brown, yellowish red, and red clay loam, sandy clay loam, and sand. Most areas in pasture and woodland have not been eroded. In places the loess thickness is less than 20 inches or more than 40 inches. Bedrock is at a depth of less than 5 feet in places.

Typically, the surface layer of a Southridge soil is dark grayish brown silt loam about 8 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is about 52 inches thick. The upper part is dark yellowish brown and yellowish brown silt loam, and the lower part to a depth of 60 inches is reddish brown clay. Most areas in pasture and woodland have not been eroded. In places the loess thickness is less than 15 inches or more than 40 inches. Bedrock is within a depth of 5 feet in places.

Included with these soils in mapping are well drained Chaseburg soils. The Chaseburg soils contain less clay than the major soils. They are in the drainageways and make up less than 5 percent of mapped areas.

Water and air move through the Blackhammer soil and the upper part of the Southridge soil at a moderate rate. Water and air movement is slow in the lower part of the Southridge soil. The available water capacity is moderate to high, and surface runoff is rapid. In both soils the silty upper part of the subsoil is high in available phosphorus and low or medium in potassium. The lower part of the subsoil and the underlying material are low in available phosphorus in both soils. They are low in available potassium in the Blackhammer soil and medium in the Southridge soil. The subsoil in both soils is slightly acid through strongly acid in the upper part and medium acid or strongly acid in the lower part. The content of organic matter in the surface layer of both soils is moderately low. In both soils the water table is below a depth of 6 feet in all seasons. Roots grow easily in the silty layers, but growth is slowed by the lower fertility and the acidity of the more firm underlying loamy and clayey layers at depths of 15 to 40 inches. These soils warm and dry early in the growing season. They are moderately easy to till. The range of soil moisture suitable for tillage is moderately wide. These soils are easily eroded. The surface layer is difficult to maintain in a friable condition.

Areas of this map unit are used mainly for cropland. Alfalfa-grass forage, corn, and small grain are the commonly grown crops. Suitability is poor for row crops, such as corn. Row crops respond well to lime and fertilizer. The main limitation is the hazard of erosion. Also, because of the rapid runoff, crops suffer from drought during years in which rainfall is below normal. Erosion can be controlled and intake of water increased if corn is grown in a rotation consisting mostly of forage crops. Growing corn and forage crops in alternating strips on the contour helps control erosion and is well suited to the long, smooth slopes. Tillage methods that leave a large amount of crop residue on the surface help reduce erosion and are well suited in areas that warm early. Applications of manure help reduce soil loss, increase water intake, and increase fertility. Slopes are too steep and the soils too shallow for conventional terraces. Deep cuts expose the clayey and loamy subsoil that is difficult to till and is low in fertility. Gullies develop easily on these soils unless drainageways crossing the areas are shaped, seeded, and maintained as grassed waterways.

Areas of these soils are well suited to forage crops and pasture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer. Potassium

is needed to maintain stands of legumes. A few mostly irregular-shaped areas of this map unit are used for pasture. Most areas of pasture are in bluegrass and contain brush and weeds. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This map unit is well suited to woodland. Some areas are grazed and can be improved by limiting grazing, which reduces natural regeneration and slows tree growth. In places thinning of undesirable trees is needed to allow for planting of preferred trees. Plant competition is severe in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage, girdling, or careful spraying with herbicides.

Slope is the main limitation to use of these soils for building sites. Extensive land shaping is generally needed. Building sites and structures should be designed to conform to the natural slope of the land. Roads need to be constructed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Using well compacted, coarse textured base material helps protect the roads from frost damage. Septic tank absorption fields are poorly suited because of the slope and because of slow permeability in the lower part of the Southridge soil. Soils that are better suited to this use are generally nearby.

This map unit is in capability subclass IVe.

584F—Lamoille-Dorerton silt loams, 30 to 45 percent slopes. This map unit consists of well drained, very steep soils on the sides of ridges along stream valleys. Slopes are long and convex. Areas are long and narrow and range from 5 to about 40 acres. They are about 40 to 60 percent Lamoille soils and 30 to 40 percent Dorerton soils. Individual areas of these two soils are so intricately intermingled or so small that to separate them in mapping was not practical.

Typically, the surface layer of a Lamoille soil is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is about 29 inches thick. The upper part is dark brown, friable silt loam, and the lower part is reddish brown, firm clay and brown, friable very cobbly clay loam. The underlying material to a depth of about 60 inches is yellowish brown, friable very cobbly loam. In drainageways and other concave positions, the silty material is as much as 40 inches thick. In a few places the fine earth fraction in the lower part of the subsoil and the underlying material is sandy loam or sandy clay loam.

Typically, the surface layer of a Dorerton soil is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is dark brown silt loam about 3 inches thick. The subsoil is about 19 inches thick. The upper part is brown, friable silt loam, and the lower part is brown cobbly loam and dark yellowish brown very cobbly loam. The underlying material to a depth of about 60 inches is yellowish brown, friable very cobbly loam. In places the cobbly loam is immediately below the surface layer. Small areas have a very dark brown surface layer 8 to 15 inches thick.

Included with these soils in mapping are small areas of well drained and moderately well drained Beavercreek soils and well drained Brodale, Eleva, and Lacrescent soils. The Beavercreek, Brodale, and Lacrescent soils are cobbly and loamy, and the Eleva soils are loamy and underlain by sandstone. Beavercreek soils are in narrow drainageways. Brodale, Lacrescent, and Eleva soils typically have strongly convex slopes. The included soils make up 10 to 15 percent of mapped areas. Outcrops of limestone and sandstone are in some areas.

Water and air move through the Lamoille soil at a moderate rate in the silty surface layer, at a slow rate in the clayey subsoil, and at a moderately rapid rate in the underlying cobbly loam. Water and air move through the Dorerton soil at a moderate rate. The available water capacity is moderate in the Lamoille soil and low in the Dorerton soil. Both soils have very rapid surface runoff. The availability of phosphorus and potassium in the subsoil is low in both soils. The subsoil of the Lamoille soil is medium acid or strongly acid in the upper part and medium acid through neutral in the lower part. The subsoil of the Dorerton soil is slightly acid or medium acid. The content of organic matter in the surface layer of both soils is low. The water table is below a depth of 6 feet in all seasons. Roots grow easily in the silty layers of both soils, but root growth is limited in the clayey subsoil of the Lamoille soil and in the cobbly subsoil of the Dorerton soil.

Most areas of this map unit are used for woodland and are fairly suited to this use. Suitability is poor for cropland and pasture. Hardwoods native to the survey area are better suited than most other species. Because of the very rapid runoff, the main limitations are the moderate available water capacity in the Lamoille soil, the low available water capacity of the Dorerton soil, and the limited moisture intake. Moisture intake can be increased by the elimination of grazing. This improves the friability of the surface layer, maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff, increases the moisture available to trees, and improves natural regeneration. Natural regeneration of hardwoods can be difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. In places clearing of undesired stock is essential to allow for restocking or replanting of preferred trees. In new plantings competing vegetation needs to be controlled to allow for good growth. This can be accomplished through the careful use of herbicides. Thinning at the proper time helps

produce optimum growth. Access roads should be built on the contour to minimize hazards of runoff and erosion. They are difficult and costly to build because of the very steep slopes. Specialized harvesting techniques are needed on these slopes. Some areas of this unit are excellent for recreation purposes. Trails that can be developed in areas of this unit give access to scenic settings.

This map unit is generally not suitable for building sites, local roads, or septic tank absorption fields because of steepness of slope. Soils that are better suited to these uses are generally nearby.

This map unit is in capability subclass VIIe.

585C—Newhouse-Valton silt loams, 6 to 12 percent slopes. This map unit consists of well drained, sloping soils on ridgetops. Slopes are long, smooth, and mostly convex. Areas are irregular in shape and range from 3 to about 15 acres. The map unit is about 35 to 65 percent Newhouse soils and 25 to 35 percent Valton soils. The Newhouse and Valton soils are on similar positions. Individual areas of these soils are so intricately intermingled or small that to separate them in mapping was not practical.

Typically, the surface layer of a Newhouse soil is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 51 inches thick. The upper 16 inches is dark yellowish brown and dark brown silt loam and silty clay loam, and the lower part is strong brown and yellowish red, stratified fine sandy loam, sandy loam, and sandy clay loam. In places the surface layer is more than 10 inches thick. Dolomite or sandstone bedrock is at a depth of less than 60 inches in places. In a few places the loamy subsoil is at a depth of less than 20 inches or more than 40 inches. Some areas that have strongly convex slopes have a dark brown surface layer that is lower in organic matter content and less friable.

Typically, the surface layer of a Valton soil is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 51 inches thick. The upper part is dark brown and yellowish brown, friable silt loam about 24 inches thick, and the lower part is yellowish red, very firm clay. Dolomite or sandstone bedrock is within a depth of 60 inches in places. The clayey subsoil is at a depth of less than 15 inches or more than 36 inches in places and can have an abrupt increase in the content of clay. Some areas that have strongly convex slopes have a dark brown surface layer that is lower in organic matter content and less friable. In places the surface layer is more than 10 inches thick and very dark brown.

Included with these soils in mapping are small areas of well drained and moderately well drained Eitzen soils. The Eitzen soils are silty and in narrow drainageways. They make up 1 to 2 percent of mapped areas.

Water and air move through the Newhouse soils and the upper part of the Valton soils at a moderate rate. They move through the lower part of the Valton soils at a slow rate. Surface runoff is medium for Newhouse soils and moderate to high for Valton soils. The available water capacity is high for both soils. The availability of phosphorus is high and potassium is low in the silty upper part of the subsoil in both soils. Available phosphorus is low in the lower part of the subsoil and underlying material in both soils. The lower part of the subsoil in the Newhouse soils is low in available potassium and is medium in the Valton soils. In Newhouse soils the subsoil is slightly acid through strongly acid in the upper part and medium acid or strongly acid in the lower part. In Valton soils the subsoil is medium acid or strongly acid in the upper part and medium acid through very strongly acid in the lower part. The content of organic matter in the surface layer of both soils is moderate. In both soils the water table is below a depth of 6 feet in all seasons. Roots grow easily in the silty layers. Root growth is slowed by the lower fertility and the acidity of the more firm loamy and clayey layers at a depth of about 15 to 40 inches. These soils warm early in the growing season. They are moderately easy to till. These soils are easily eroded by water. They tend to puddle during rains and form a crust on drying. The crusting reduces the intake of air and water.

Most areas of this map unit are used for cropland. Some areas are in pasture. Corn, alfalfa-grass forage, and small grain are the commonly grown crops. Suitability is fair for row crops, such as corn. Row crops respond well to lime and fertilizer. The hazard of erosion is the main limitation for row crops. In the years when rainfall is low, crops suffer from insufficient moisture. Erosion can be controlled by growing corn in a rotation with forage crops or by using tillage methods that leave large amounts of crop residue on the surface. Growing corn and forage crops in alternating strips on the contour is well suited to the long, smooth slopes. Applications of manure also reduce erosion, increase the intake of air and water, and improve fertility. Drainageways crossing these soils develop gullies easily. Gully erosion can be controlled by shaping, seeding, and maintaining drainageways as grassed waterways.

This map unit is well suited to forage crops and pasture. Suitable varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer on these soils. A few mostly irregular-shaped areas are used for pasture. Most pasture is bluegrass. The pasture in many of the areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forages efficiently and maintain the sod in good condition.

Areas of this map unit are well suited to trees, but only a few areas are in woodland. Some areas are grazed and can be improved by limiting grazing, which lowers

natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for restocking or replanting of preferred trees. Plant competition is severe in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage methods or by careful spraying with herbicides.

Buildings constructed on these soils should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the Valton soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. The slope and slow and moderate permeability restrict these soils from readily absorbing effluent from septic tank absorption fields. Installing a larger than average drain field and placing distribution lines across the slope help overcome these limitations.

This map unit is in capability subclass IIIe.

585D—Newhouse-Valton silt loams, 12 to 20 percent slopes. This map unit consists of well drained, moderately steep soils on ridgetops. Slopes are long, smooth, and mostly convex. Areas are elongated and range from 3 to about 15 acres. They are about 25 to 50 percent Newhouse soils and 25 to 40 percent Valton soils. The Newhouse and Valton soils are on the same landscape positions. Individual areas of these soils are so intricately intermingled or small that to separate them in mapping was not practical.

Typically, the surface layer of a Newhouse soil is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper 21 inches is dark yellowish brown, friable silt loam, and the lower part is strong brown and yellowish red, stratified clay loam, sandy loam, and fine sandy loam. In a few places the loamy subsoil is shallower than 15 inches or deeper than 30 inches. In a few moderately eroded areas, the surface layer is dark brown.

Typically, the surface layer of a Valton soil is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 51 inches thick. The upper part is dark brown and yellowish brown, friable silt loam, and the lower part is yellowish red, very firm clay. In a few places the clayey subsoil is shallower than 15 inches or deeper than 36 inches and can have an abrupt increase in the content of clay. In a few moderately eroded areas, the surface layer is dark brown.

Water and air move through the Newhouse soils and the upper part of the Valton soils at a moderate rate. They move through the lower part of the Valton soils at a slow rate. The available water capacity is high in the Newhouse soils and moderate to high in the Valton soils. Surface runoff is rapid for both soils. The availability of phosphorus is high and potassium is low in the silty upper part of the subsoil in both soils. The availability of phosphorus in the lower part of the subsoil and underlying material of both soils is low. The available potassium in the lower part of the subsoil is low in Newhouse soils and is medium in Valton soils. The subsoil in Newhouse soils is slightly acid through strongly acid in the upper part and medium acid or strongly acid in the lower part. In Valton soils the subsoil is medium acid or strongly acid in the upper part and medium acid through very strongly acid in the lower part. The content of organic matter in the surface layer of both soils is moderate. In both soils the water table is below a depth of 6 feet in all seasons. Roots grow easily in the silty layers but are slowed in the more firm loamy and clayey layers because of the lower fertility and the acidity. These soils warm and dry early in the growing season. They are moderately easy to till. They are easily eroded by water.

Most areas of this map unit are used for cropland and pasture. Corn, alfalfa-forage, and small grain are the commonly grown crops. Suitability is poor for row crops, such as corn. The main limitation to cropping is the erosion hazard. Because runoff is rapid and the moisture storage capacity for crops is limited, crops such as corn suffer from insufficient moisture during seasons in which rainfall is below normal. Erosion can be controlled if row crops are grown in a rotation consisting mainly of forage crops. Growing forage crops and corn in alternating strips on the contour is well suited to the long, smooth slopes. Tillage methods that leave large amounts of crop residue on the surface are also well suited to the soils that warm early. Applications of manure reduce soil losses, increase intake of water and air, and improve fertility. Gullies develop easily in these soils. Gully erosion can be controlled by shaping drainageways that cross areas of these soils and seeding and maintaining them as grassed waterways.

Areas of this map unit are well suited to forage crops and pasture (fig 12). Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase yield and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer. Potassium is needed to maintain stands of legumes. Some areas of this map unit are used for pasture. Most pasture is bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Renovating pasture by seeding directly into sod helps prevent erosion. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

Figure 12.—An area of Newhouse-Valton silt loams, 12 to 20 percent slopes, in pasture. Mt. Carroll and Port Byron soils that have slope of 3 to 12 percent are on the summits.

A few areas of this map unit are in woodland. Trees are well suited. Some areas are grazed and can be improved by limiting grazing, which lowers natural regeneration and slows tree growth. Thinning of undesirable trees is needed in places to allow for restocking or replanting of preferred trees. Plant competition is severe in new plantations. Competing vegetation, such as brush and weeds, can be controlled by tillage methods or by careful spraying with herbicides.

This map unit is poorly suited to building site development because of slope and because of structural damage resulting from shrinking and swelling of the Valton soil. The foundations and footings of buildings should be designed to prevent structural damage caused by the shrinking and swelling of the Valton soil. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Roads should be constructed on the contour, where possible, and roadbanks need to be planted to well adapted grasses to minimize the erosion hazard. This map unit is poorly suited to use as septic tank

absorption fields because of slope and because the permeability of these soils restricts them from readily absorbing effluent. Soils that are better suited to this use are generally nearby.

This map unit is in capability subclass IVe.

586C2—Nodine-Rollingstone silt loams, 4 to 12 percent slopes, eroded. This map unit consists of well drained, gently sloping to sloping soils on crests near the ends of long, narrow ridges. Slopes are convex. Areas are mainly elongated and range from 3 to about 10 acres. They are about 35 to 50 percent Nodine soils and 30 to 45 percent Rollinstone soils. The Nodine and Rollingstone soils are on similar positions. Individual areas of these soils are so intricately intermingled or small that to separate them in mapping was not practical.

Typically, the surface layer of a Nodine soil is dark grayish brown silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper 3 inches is dark yellowish brown silt loam, and the lower part to a depth of about 60 inches is multicolored clay, clay loam, sandy clay loam, sandy loam, and loamy sand. Most areas in pasture and woodland have not been eroded. In a few places dolomitic or sandstone bedrock is within a depth of 5 feet. The most severely eroded convex parts of the slope have a dark brown loamy surface layer that is lower in content of organic matter and is less friable. Cobbles and chert are on the surface of these eroded soils. The silty layers are more than 15 inches thick in places.

Typically, the surface layer of a Rollingstone soil is dark grayish brown silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper 7 inches is dark yellowish brown, friable silt loam, and the lower part to a depth of about 60 inches is red cherty clay. Most areas in pasture and woodland have not been eroded. In places dolomite or sandstone bedrock is within a depth of 5 feet. The silty layers are more than 15 inches thick in places. The most severely eroded convex parts of the slope have a brown loamy to clayey surface layer that is lower in content of organic matter and is less friable. Cobbles and chert cover as much as 15 percent of the surface in places. A few small concave areas have a thicker, darker colored surface layer.

Included with these soils in mapping are small areas of well drained Seaton soils. The Seaton soils are silty throughout and have plane and concave slopes. They make up about 2 to 5 percent of mapped areas.

Water and air move through the Nodine soils and through the silty upper layers of the Rollingstone soils at a moderate rate. Water and air move through the subsoil of Rollingstone soils at a slow rate. The available water capacity is moderate in the Nodine and Rollingstone soils, and surface runoff is medium. The availability of phosphorus and potassium in the subsoil is low for both soils. The silty subsoil of both soils is slightly acid through strongly acid. The clayey part of the subsoil in Rollingstone soils is strongly acid or very strongly acid. The loamy subsoil in Nodine soils is medium acid or strongly acid. The content of organic matter in the surface layer is moderately low in both soils. The water table is below a depth of 6 feet in all seasons. Roots grow easily in the silty layers, but root development is slowed in the loamy and clayey subsoil by the lower fertility and the acidity. These soils warm and dry early in the growing season. They are moderately easy to till. The surface layer of these soils tends to puddle during rains and forms a crust upon drying. This crusting reduces intake of air and water. A friable surface layer is difficult to maintain. These soils are easily eroded.

Most areas of this map unit are used for cropland, pasture, and woodland. Alfalfa-grass forage, small grain, and corn are the common crops. Suitability is poor for row crops, such as corn, because of the hazard of erosion. Also, corn yields are low in most years because of insufficient moisture. If erosion is to be controlled, row crops should be grown only occasionally. Drainageways should be shaped, seeded, and maintained as grassed waterways to prevent gully erosion.

The soils in this unit have fair suitability for forage crops and pasture. The moderate available water capacity is the main limitation. Forage and pasture production is low during summer because of the lack of moisture. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer. Potassium is needed to maintain stands of legumes. Many areas of pasture are bluegrass, and in these areas yields can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds increase production. Proper rates of stocking and rotating of pasture utilize forage efficiently and maintain the sod in good condition.

These soils are well suited to trees. Many areas are in native hardwoods. Pruning and thinning trees dramatically increase quality and growth. Areas poorly stocked can be cleared and replanted with desired trees or allowed to regenerate naturally. Herbicides may be needed to suppress competition in new plantings. These soils have an advantage for uses other than cropland, such as sites for apple orchards. Areas sloping to the northeast, north, and east are possible sites for orchards.

Buildings constructed on these soils should be designed to conform to the natural slope of the land. Land shaping is necessary in some areas. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of these soils. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Large stones in the Rollingstone soils hamper

construction efforts in some areas. Roads constructed on these soils need to be placed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Using well compacted, coarse textured base material helps protect roads from damage caused by frost action, shrinking and swelling of the Nodine soils, and low strength of the Rollingstone soils. The slope and slow and moderate permeability restrict these soils from readily absorbing effluent from septic tank absorption fields. Installing a larger than average absorption field and placing distribution lines across the slope help overcome these limitations.

This map unit is in capability subclass IIIe.

586D2—Nodine-Rollingstone silt loams, 12 to 20 percent slopes, eroded. This map unit consists of well drained, moderately steep soils on the narrow ridgetops. Slopes are convex. Areas are elongated and range from 3 to about 10 acres. They are about 25 to 55 percent Nodine soils and 25 to 35 percent Rollingstone soils. The Nodine and Rollingstone soils are on similar positions. Individual areas of these soils are so intricately intermingled or so small that to separate them in mapping was not practical.

Typically, the surface layer of a Nodine soil is dark grayish brown silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper 5 inches is dark yellowish brown silt loam, and the lower part to a depth of about 60 inches is stratified, multicolored clay, sandy clay loam, sandy loam, and loamy sand. Most areas in pasture and woodland have not been eroded. In places a cobbly loam layer is within a depth of 5 feet. Dolomite or sandstone bedrock is within a depth of 5 feet in some areas that have strongly convex slopes. The most severely eroded convex parts of the slope have a dark brown loamy surface layer that is lower in organic matter and is less friable. Small amounts of gravel and cobbles are on the surface. A few areas have a very dark brown surface layer.

Typically, the surface layer of a Rollingstone soil is dark grayish brown silt loam about 6 inches thick. The subsoil is about 54 inches thick. The upper 7 inches is dark yellowish brown silt loam, and the lower part is red cherty clay to a depth of about 60 inches. Most areas in pasture and woodland have not been eroded. Dolomite or sandstone bedrock is within a depth of 5 feet in some areas that have strongly convex slopes. The most severely eroded convex parts of the slope have a dark brown loamy to clayey surface layer that is lower in content of organic matter and less friable. Cobbles and pebbles are common on the surface of this eroded soil.

Included with these soils in mapping are small areas of well drained Chaseburg and Seaton soils and outcrops of bedrock. The silty Chaseburg soils are in drainageways and make up 1 to 5 percent of mapped areas. The Seaton soils are silty throughout and mainly have plane and slightly concave slopes. They make up about 2 to 5 percent of mapped areas. The outcrops make up less than 1 percent of mapped areas.

Water and air move through the Nodine soils and through the silty upper layers of the Rollingstone soils at a moderate rate. Water and air move through the clayey subsoil of the Rollingstone soils at a slow rate. Both Nodine and Rollingstone soils have moderate available water capacity and rapid surface runoff. The availability of phosphorus and potassium in the subsoil is low for both soils. The silty subsoil of both soils is slightly acid through strongly acid. The loamy subsoil of the Nodine soils is medium acid or strongly acid. The clayey part of the subsoil of the Rollingstone soils is strongly acid or very strongly acid. The content of organic matter is moderately low in both soils. The water table is below a depth of 6 feet in all seasons. Roots grow easily in the silty layers, but root development is slowed in the loamy and clayey subsoil by the lower fertility and the acidity. These soils warm and dry early in the growing season. They are moderately easy to till. The surface layer tends to puddle during rains and to form a crust upon drying. The crusting reduces the intake of air and water. The surface layer is difficult to maintain in a friable condition. These soils are easily eroded.

Most areas of this map unit are used for cropland, pasture, and woodland. Suitability is poor for row crops, such as corn, because of the severe hazard of erosion. Also, corn yields are low in most years because of insufficient moisture.

These soils are better suited to forage and pasture than to most other crops. Production is lower in the warm, dry summer because of the moderate available water capacity. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and pasture yields can be increased by planting to more productive species. Renovating pasture by seeding directly into the sod helps prevent erosion. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds increase production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Some areas of this map unit are used for woodland. Trees are well suited to these soils. Most woodland areas are in native hardwoods. Pruning and thinning trees increase quality and rate of growth. Areas that are poorly stocked can be cleared and replanted to desired trees or allowed to regenerate naturally. Herbicides may be needed to suppress competition in new plantings. In places these soils are used for apple orchards. Northeast and east aspects are better suited than other aspects. Erosion can be controlled by keeping the space between trees in legumes and grasses.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. The shrinking and swelling of these soils and large stones in the Rollingstone soils are moderate limitations that should be recognized. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of these soils. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. These soils are poorly suited to road construction because of slope and low soil strength. Large amounts of cutting and filling are generally needed in road construction, and well compacted, coarse textured base material should be used to help protect roads from damage caused by low soil strength. Constructing roads on the contour, where possible, and planting roadbanks to well adapted grasses help to minimize the erosion hazard. These soils are poorly suited to septic tank absorption fields because of slope and because the permeability of these soils restricts them from readily absorbing effluent. Soils that are better suited to this use are generally nearby.

This map unit is in capability subclass IVe.

592E—Lamoille-Elbaville silt loams, 20 to 30 percent slopes. This map unit consists of well drained soils on the upper side slopes of ridges. Drains and gullies dissect these soils in places. Areas are long and narrow and range from 5 to about 15 acres. They are 50 to 70 percent Lamoille soils and soils similar to Lamoille soils and 15 to 25 percent Elbaville soils. The Lamoille soils are on the most convex parts of the slope, and Elbaville soils are mainly on concave positions. In a few places, mostly on east-facing slopes, Elbaville soils make up most of the unit. Individual areas of these soils are so intricately intermingled or so small that to separate them in mapping was not practical.

Typically, the surface layer of a Lamoille soil is very dark grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is about 41 inches thick. The upper 3 inches is brown, friable silt loam; the middle part is brown, firm clay; and the lower part is firm, clay loam. The underlying material is grayish brown cobbly loam to a depth of 60 inches or more. In places dolomite or sandstone bedrock is within a depth of 40 inches. The silt loam layer is as much as 40 inches thick in places. Areas that have strongly convex slopes have been eroded in places. They have a dark brown surface layer and are low in content of organic matter. In places fine earth in the lower part of the subsoil and in the underlying material is loamy sand or sandy loam.

Typically, the surface layer of an Elbaville soil is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is dark grayish brown, very friable silt loam about 5 inches thick. The subsoil is about 28 inches. The upper part is dark yellowish brown, friable silt loam, and the lower part is dark brown, firm cherty clay. The underlying material is dark brown and yellowish brown cobbly loam to a depth of about 60 inches. In places fine earth in the lower part of the subsoil and underlying material is loamy sand or sandy loam. Sandstone or dolomite is at a depth of less than 40 inches in places. A few small areas that have concave slopes have a thicker, darker colored surface layer.

Included with these soils in mapping are small areas of moderately well drained Beavercreek soils, well drained Chaseburg soils, well drained and somewhat excessively drained Eleva soils, and excessively drained Sogn soils. Also included are outcrops of rock in places. The Beavercreek soils are cobbly and loamy throughout, and Chaseburg soils are silty throughout. The Eleva and Sogn soils are loamy and on positions similar to those of the major soils along the upper parts of valleys. The Eleva soils are moderately deep to sandstone bedrock, and Sogn soils are shallow dolomite bedrock. The included soils make up about 10 to 15 percent of mapped areas.

Water and air move through the subsoil of the Lamoille soils at a slow to moderately slow rate and through the Elbaville subsoil at a moderately slow rate. The available water capacity is moderate in the Lamoille soils and is high in the Elbaville soils. Surface runoff is rapid on both soils. The availability of potassium in the subsoil is low in both soils. The availability of phosphorus is low in the Lamoille soils and high in the Elbaville soils. The subsoil is medium acid or moderately acid in both soils. The content of organic matter in the surface layer is moderately low in the Elbaville soils and low in the Lamoille soils. The water table is below a depth of 6 feet in all seasons in both soils. The rooting zone extends to a depth of 40 inches or more in the Lamoille soils, although root growth is limited somewhat by the clayey subsoil and cobbly underlying material. The rooting zone of the Elbaville soils extends to a depth of 60 inches or more in most places.

Most areas of this map unit are used for pasture or woodland. Suitability is fair for pasture. Pasture productivity is limited by the moderate available water capacity in the Lamoille soils and by the rapid runoff, which limits intake of moisture. The hazard of erosion is severe if the soils are tilled. Pasture is mostly bluegrass, which is unproductive during the warm summer. Productivity can be increased where the slopes do not hinder planting to more productive species. Renovation of pasture is difficult in many places because of steepness of slope and because of uncrossable gullies, which hinder the use of farm machinery. Erosion during the establishment period can be minimized by leaving the seedbed as rough as possible, keeping much of the old sod residue on the surface, and mulching with manure. Seeding mixtures that contain a high proportion of grasses should be used to produce a dense, erosion-

resistant sod. Erosion can be controlled during renovation by seeding directly into old sod. Lime is needed to establish legumes, and potassium is needed to maintain stands. Yields of pasture can be increased by allowing plants to reach the proper height before grazing. Where slope is not a hindrance, clipping mature plants and controlling weeds further increase yields of forage. Using proper stocking rates and rotating pasture utilize forages efficiently and maintain the sod in good condition. Controlled grazing is needed. Overgrazing these easily erodible soils causes gullies to form that are hard to stabilize.

These soils have fair suitability for trees. Rapid runoff, moderate available water capacity, and compact clay subsoil which retards root growth are the major limitations affecting the growth of trees. Hardwoods native to the area, such as northern red oak, are better suited than some other species. In places clearing of undesired stock in stands is essential to the restocking or replanting of preferred trees. Natural regeneration of hardwoods can be difficult because of destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves surface tilth and maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff. This increases moisture for tree growth, reduces flooding on lower lying areas, and improves natural regeneration. In new plantings competing vegetation should be controlled to allow for good growth. This can be accomplished through the careful use of herbicides. Thinning at the proper times helps encourage optimum growth. Care must be taken when harvesting trees to control erosion. Logging roads should be built on the contour wherever possible to minimize the hazard of runoff.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. The Lamoille soils are poorly suited to road construction because of the slope and low strength. Large amounts of cutting and filling are generally needed, and well compacted, coarse textured base material should be used to help protect roads from damage caused by low soil strength. Placing roads on the contour, where possible, and planting roadbanks to well adapted grasses help minimize the erosion hazard. This map unit is poorly suited to use as septic tank absorption fields because of slope and because the permeability of these soils restricts them from readily absorbing effluent. Soils that are better suited to this use are generally nearby.

This map unit is in capability subclass VIe.

593F—Elbaville silt loam, 30 to 45 percent slopes. This well drained, very steep soil is on foot slopes below very steep sides of ridges along valleys. Slopes are slightly concave or nearly plane. Gullies and drainageways cross this soil at irregular intervals. Areas are elongated and range from 5 to about 50 acres.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 7 inches thick. The subsoil is about 19 inches thick. The upper part is dark yellowish brown silt loam, and the lower part is dark brown gravelly clay loam. The underlying material to a depth of about 60 inches is yellowish brown and light olive brown very cobbly loam. Small areas are underlain by olive gray or grayish brown platy sandstone or yellowish brown sandstone within a depth of 60 inches. In a few places the underlying material is yellowish brown loamy sand below a depth of 40 inches. Some areas on south- and west-facing slopes have a surface layer 7 to 20 inches thick that is black or very dark grayish brown. Many places have small amounts of cobbles and pebbles on the surface.

Included with this soil in mapping are small areas of well drained to moderately well drained Beavercreek soils, excessively drained Brodale soils, and well drained Lacrescent soils. The Beavercreek soils are cobbly and loamy and are in drainageways. They make up 1 to 5 percent of mapped areas. The Brodale and Lacrescent soils are cobbly and loamy and on very steep convex sides of ridges. They make up 2 to 4 percent of mapped areas.

Water and air move through the subsoil at a moderately slow rate. The available water capacity is high. However, very rapid surface runoff limits the moisture supply by reducing the amount of water actually entering the soil. The availability of phosphorus is medium or high and potassium is low in the subsoil. The surface layer is neutral through medium acid, the subsoil is slightly acid or medium acid, and the underlying material is mildly alkaline. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. Below a depth of 15 to 30 inches the rooting zone is somewhat restricted by the clay or clay loam subsoil.

Most areas of this soil are used for woodland. A few areas are pastured. This soil is well suited to woodland. In places clearing of undesired stock in stands is essential to the restocking or replanting of preferred trees. Natural regeneration of hardwoods can be difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves friability of the surface layer and maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff. This increases moisture for tree growth and improves natural regeneration. South- and west-facing slopes have warm, dry exposures and are better suited to drought-tolerant

species, such as red pine. In new plantings competing plants need to be controlled to allow for good growth. This can be accomplished through the careful use of herbicides or girdling to kill unwanted trees. Thinning at the proper times helps produce optimum growth. Access roads built on the contour minimize the hazards of runoff and erosion.

Some areas of this soil are used for pasture but are poorly suited to this use. Very steep slopes and the hazard of erosion are the main limitations. Gullies develop easily in this soil. This soil is too steep to renovate with farm machinery. Erosion can be controlled by careful control of stocking rates and good grazing management. This soil is poorly suited to row crops and forage crops because of the very steep slopes.

This soil is generally not suitable for building sites, local roads, or septic tank absorption fields because of steepness of slope. Soils that are better suited to these uses are generally nearby.

This soil is in capability subclass VIIe.

598B—Beavercreek-Arenzville complex, 1 to 12 percent slopes. This map unit consists of nearly level to sloping, well drained and moderately well drained soils on alluvial fans and the upper reaches of narrow valleys. These soils are occasionally flooded. Most areas are dissected by intermittently flowing channels, but a few areas are next to streams that flow year-round. Areas are elongated or fan-shaped and range from 3 to about 15 acres. They contain 60 to 80 percent Beavercreek soils and soils similar to Beavercreek soils and 10 to 20 percent Arenzville soils and soils similar to Arenzville soils. The Beavercreek soils are mostly on fans and the lower levels along stream channels. The Arenzville soils are typically on the higher levels along channels. Individual areas of these soils are so intricately intermingled or so small that to separate them in mapping was not practical.

Typically, the surface layer of a Beavercreek soil is dark brown fine sandy loam about 5 inches thick. The upper 7 inches of the underlying material is stratified, pale brown and brown fine sand and dark grayish brown silt loam, and the lower part is dark grayish brown, brown, and pale brown cobbly fine sandy loam, cobbly silt loam, cobbly fine sand, cobbly loamy fine sand, and sand to a depth of about 60 inches. The upper mantle is sandy in a few places along streams. On benches, slightly elevated above the flood plain, the surface layer is black or very dark brown loam or silt loam 8 to 20 inches thick. The surface in places is covered with as much as 80 percent cobbles and pebbles. In places the cobbly layer is below a depth of 25 inches.

Typically, the surface layer of an Arenzville soil is stratified, brown and very dark grayish brown, very friable silt loam about 30 inches thick. The underlying material is a buried soil about 30 inches thick. The upper 22 inches is black, friable loam, and the lower 8 inches is dark brown, friable loam. In places this soil has a small amount of cobbles and pebbles. In places the surface layer is very dark brown loam, and the subsoil is dark brown. Small areas are somewhat poorly drained.

Included with these soils in mapping are small areas of well drained Elbaville soils and poorly drained to very poorly drained Root soils. The Elbaville soils have a thicker loamy mantle and are on foot slopes, and the Root soils are cobbly throughout and are near flowing streams. The included soils make up 5 to 15 percent of mapped areas.

Water and air move through the Beavercreek soils at a moderately rapid rate and through the Arenzville soils at a moderate rate. Available water capacity is low in the Beavercreek soils and very high in the Arenzville soils. Typically, surface runoff from the Beavercreek soils is medium, but under high intensity storms runoff is rapid. Runoff from the Arenzville soils is slow. The availability of phosphorus and potassium in the subsoil is low in the Beavercreek soils. In the subsoil the availability of phosphorus is high and potassium is low or medium in the Arenzville soils. Reaction throughout the Beavercreek soils is neutral. The subsoil of the Arenzville soils is neutral or mildly alkaline. The content of organic matter in the surface layer of the Beavercreek soils is low. It is moderately low to moderate in the Arenzville soils. The water table is below a depth of 6 feet in the Beavercreek soils and is at a depth of 3 to 6 feet in the Arenzville soils. The rooting zone is restricted by the large amount of cobbles in the Beavercreek soils. It extends to a depth of 60 inches or more in the Arenzville soils.

Most areas of this map unit are used for pasture, and suitability is fair for this use. Yields of bluegrass are low during summer because of insufficient moisture and warm temperatures. Pasture improvement is difficult in most places because of the poor seedbed on the Beavercreek soils and lack of access to renovating and seeding equipment. In places recent floods have deposited a very cobbly sediment that does not support plant growth. In some areas clearing of brush improves pasture. Pasture production can be increased by allowing plants to reach the proper height before grazing. Proper stocking rates and rotating pasture result in maximum harvest and keep the pasture in good condition.

Some areas of this map unit are in woodland. The Beavercreek soils are poorly suited to trees. Growth is limited by the low moisture supply and shallow rooting zone. The Arenzville soils and other small areas where the soil is deeper are well suited to oaks and black walnut. In most places inaccessibility and the cobbly surface layer of the Beavercreek soils limit the use of mechanized planting and weed control equipment.

This map unit is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, well

compacted fill material and providing adequate side ditches and culverts help protect the roads from flooding and frost damage.

This map unit is in capabilty subclass VIs.

599E2—Norden silt loam, 15 to 30 percent slopes, eroded. This well drained, steep soil is on low, short, narrow ridges that extend from very steep hillsides along valleys. Slopes are short. Areas are irregular or long and narrow in shape and range from 3 to about 10 acres.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 25 inches thick. The upper part is dark yellowish brown loam, and the lower part is olive brown and olive loam. The underlying material to a depth of about 47 inches is weathered, olive glauconitic sandstone that crushes to sandy loam. Olive sandstone is below the underlying material. Some areas have a dark brown surface layer. In some areas the surface layer is loam or sandy loam and contains many sandstone fragments. The surface layer and the subsoil are sandy loam in places.

Included with this soil in mapping are small areas of well drained Chaseburg, Council, La Farge, and Seaton soils and somewhat excessively drained Eleva soils. The Chaseburg soils contain less clay and are in narrow drainageways that dissect this Norden soil. They make up about 1 to 2 percent of mapped areas. The Council soils contain less clay, and Seaton soils are silty throughout. These soils are in coves and concave positions and make up about 1 to 3 percent of mapped areas. The Eleva soils contain more sand and are underlain by yellowish brown sandstone. They are on nose positions or at the ends of short spurlike knolls or ridges and make up about 1 to 3 percent of mapped areas. The La Farge soils have a thicker mantle of loess than this Norden soil and are on similar positions. They make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. Surface runoff is rapid. The available water capacity is moderate. The content of organic matter in the surface layer is moderately low. The availability of phosphorus and potassium in the subsoil is medium. The upper part of the pedon is slightly acid through strongly acid, and the lower part is neutral through very strongly acid. The rooting zone extends to a depth of more than 24 inches, but roots are somewhat restricted by the fragments of sandstone. The water table is below a depth of 6 feet in all seasons.

Most areas of this soil are in cropland and pasture. Areas are small and somewhat scattered. They are generally managed with the dominant nearby soil. This soil is poorly suited to cultivated crops because of the severe hazard of erosion and moderate available water capacity. Cropping systems consisting mostly of hay crops help to control erosion.

This soil has fair suitability for forage crops and pasture. The hazard of erosion is the main limitation. Moderate moisture capacity and rapid runoff are additional limitations. The hazard of erosion is severe when forage crops are replanted or pasture is renovated. Erosion can be reduced during renovation or reseeding periods by using tillage methods that leave large amounts of residue on the surface, preparing cloddy seedbeds, and applying manure as mulch after seeding. Seeding mixtures that contain a high proportion of grasses produce a dense, erosion-resistant sod. Interseeding legumes directly into sod can also improve pasture and forage quality. Potassium is needed to maintain stands of legumes.

Forage crops and pasture are productive during the normally moist, cool spring and in early fall. During the warm, dry summer forage crops and pasture are generally unproductive because of insufficient moisture. Allowing plants to reach the proper height before grazing or harvesting increases yields and quality of forage and pasture. Controlling weeds and clipping mature plants, where slopes allow, also increase pasture yields. Using proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition. Maintaining a dense sod reduces runoff, increases moisture for plants, and protects the soil from erosion.

This soil has fair suitability for woodland. Existing woodlands can be improved by removing undesirable species. Oaks are difficult to regenerate because seedlings are destroyed by rodents and insects. Eliminating grazing from woodland helps regenerate vegetation, improves surface tilth, and maintains the spongelike mulch of leaves which absorbs large amounts precipitation and runoff. These practices increase the amount of moisture available for tree growth. Competing vegetation in new plantings needs to be controlled. This can be done by careful spraying with herbicides or by tilling.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed when constructing roads on this soil. Roads need to be placed on the contour, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields. The bedrock hinders installation operations in some areas.

This soil is in capability subclass VIe.

599F—Norden silt loam, 30 to 45 percent slopes. This well drained, very steep soil is on low, narrow ridges that extend from the side slopes of nearby ridges at higher elevations. Slopes are short and mostly convex. Areas are irregular or long and narrow in shape and range from 3 to about 8 acres.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 34 inches thick and contains many fragments of greenish gray sandstone. The upper part is yellowish brown loam, and the lower part is greenish gray and olive brown clay loam. Platy, greenish gray cemented sandstone is at a depth of about 42 inches. In small areas the surface layer and subsoil are sandy loam.

Included with this soil in mapping are well drained Council, Eleva, Lacrescent, and Seaton soils. The Council soils contain less clay than this Norden soil, and Seaton soils are silty throughout. They are in concave areas and shallow draws and make up 1 to 2 percent of mapped areas. The Eleva soils contain more sand and are underlain by yellowish brown sandstone. They typically are on the lower part of side slopes and make up 1 to 10 percent of mapped areas. The Lacrescent soils have a very cobbly subsoil. They are on the highest positions and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. Surface runoff is rapid. The available water capacity is moderate. The availability of phosphorus and potassium in the subsoil is medium. The upper part of the pedon is slightly acid through strongly acid, and the lower part is neutral through very strongly acid. The content of organic matter in the surface layer is moderately low. Roots grow easily to a depth of about 24 inches, but roots are somewhat restricted below this depth by the fragments of sandstone. The water table is below a depth of 6 feet in all seasons.

Most areas of this soil are used as woodland. Suitability is fair for native hardwoods. The moderate available water capacity is the main limitation. Clearing of undesired stock is essential to the replanting of preferred trees. Natural regeneration of hardwoods can be difficult because of destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves the friability of the surface layer and maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff. The mulch increases moisture for tree growth and improves natural regeneration beneath the existing forest canopy. Control of competing plants promotes good growth of desired species. This can be done by careful spraying with herbicides. Slopes are generally too steep for mechanical planters, and seedlings are generally planted by hand. This soil is not suited to cultivated crops because of steepness of slopes.

This soil is generally not suitable for building sites, local roads, or septic tank absorption fields because of steepness of slopes. Soils that are better suited to these uses are generally nearby.

This soil is in capability subclass VIIe.

601D2—Council fine sandy loam, 12 to 20 percent slopes, eroded. This moderately steep to steep, well drained soil is on foot slopes. Slopes are plane to slightly convex. Areas are elongated and range from 3 to about 10 acres.

Typically, the surface layer is very dark grayish brown fine sandy loam about 7 inches thick. A small amount of material from the upper part of the subsoil has been mixed with the surface layer. The subsoil is about 47 inches thick. The upper part is brown, friable sandy loam, the middle part is dark yellowish brown loam, and the lower part is dark yellowish brown silt loam. The underlying material to a depth of 60 inches is yellowish brown silt loam. Areas that are in pasture and woodland have not been eroded. In places the surface layer is sand or loamy sand. Cobbly gravelly loam, or sandy loam, or grayish platy sandstone bedrock is within a depth of 60 inches in places.

Included with this soil in mapping are small areas of well drained and moderately well drained Chaseburg soils. The Chaseburg soils are silty and are in drainageways. They make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. The available water capacity is moderate, and surface runoff is rapid. In the subsoil the availability of phosphorus is high and potassium is low. The subsoil is slightly acid or medium acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends below a depth of 60 inches. The soil warms and dries early in the growing season. It is easy to till and can be tilled satisfactorily through a wide range of soil moisture. Because of the moderately low content of organic matter, the surface layer is easily eroded. It also tends to crust upon drying after hard rains.

Most areas of this soil are used as cropland. Some areas are in pasture or woodland. Alfalfa-grass forage, corn, and small grain are the main crops grown. Suitability is poor for row crops, such as corn, and is fair for small grain. The major limitation to row crops is the hazard of erosion. The hazard of erosion is severe because of the long slopes and easily erodible soil. Growing forages and corn in alternating strips on the contour and tillage methods that leave large amounts of crop residue on the surface help reduce soil losses. These practices along with applications of manure reduce crusting, increase intake of air and water, and improve fertility. Gullies develop easily in this soil. Gullies can be repaired and prevented by shaping, reseeding, and maintaining as grassed waterways. During years when

rainfall distribution is below normal, crops suffer from insufficient moisture.

This soil is well suited to forage crops and pasture. Forage crops make good use of available moisture in the early and late parts of the growing season and in the cooler temperatures at these times. Suitable plant varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and pasture yields can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production of pasture. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Small areas of this soil are in woodland. Trees grow well on this soil. Most areas of woodland can be improved and the quality and value of trees can be increased by thinning and pruning existing stands. Seeds and seedlings in new plantings must be protected from competition from other plants. This can be done by tillage, girdling unwanted trees, or using herbicides. Care must be exercised when harvesting to keep soil erosion to a minimum.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed when constructing roads on this soil. Roads need to be placed on the contour, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IVe.

601E—Council sandy loam, 20 to 30 percent slopes. This steep to very steep, well drained soil is on the upper parts of foot slopes below the very steep sides of ridges along stream valleys. Slopes are convex to slightly concave. Gullies and narrow drainageways cross this soil at irregular intervals. Areas are long and narrow and tend to wind around the base of steep side slopes. They are 3 to about 40 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 3 inches thick. The subsurface layer is dark grayish brown sandy loam about 11 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown sandy loam. The lower part of the subsoil and the underlying material to a depth of about 60 inches are yellowish brown loam. Small amounts of sandstone and limestone are on and in the soil in some areas. Some areas have been eroded, and the surface layer is brown and low in organic matter. In some areas the surface layer and subsoil are silt loam, and in some areas the surface layer is sand or loamy sand. In places grayish sandstone or cobbly gravelly loam or sandy loam is within a depth of 60 inches.

Included with this soil in mapping are small areas of well drained to moderately well drained Beavercreek soils, well drained and moderately well drained Chaseburg soils, well drained Eleva soils, and well drained Norden soils. The Beavercreek soils formed in cobbly material in drainageways. They make up 1 to 2 percent of mapped areas. The Chaseburg soils are silty, in drainageways, and make up 1 to 5 percent of mapped areas. The Eleva and Norden soils have a strongly convex surface. The Eleva soils are underlain by sandstone within a depth of 40 inches and make up 1 to 2 percent of mapped areas. The Norden soils have a subsoil in which the loamy lower part formed from grayish platy sandstone. They make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is moderate, but the soil is seldom filled to capacity because of the rapid runoff. In the subsoil the availability of phosphorus is high and potassium is low. The subsoil is slightly acid or medium acid. The content of organic matter in the surface layer is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone extends below a depth of 60 inches.

Most areas of this soil are used for pasture. Some areas are in woodland. This soil is poorly suited to row crops because of the steepness of slope and the severe hazard of erosion. It has fair suitability for pasture and forage crops. The hazard of erosion is the major limitation. Forage and pasture production is low during the dry summer. Most cleared areas of this soil are in bluegrass. Where slopes allow, the pasture can be improved by seeding to more productive species. The hazard of erosion is severe when pasture is renovated or forage crops are replanted. Erosion can be reduced during renovation or reseeding periods by maintaining large amounts of sod residue on the surface, preparing seedbeds as cloddy as possible, and applying manure as a mulch after seeding. Seeding mixtures that contain a high proportion of grasses are needed to produce a dense, erosion-resistant sod.

Interseeding legumes directly into the grasses can also improve pasture quality. This soil responds well to lime and fertilizer. Potassium is needed to maintain stands of legumes. Maintaining a dense sod cover increases intake of water. Allowing plants to reach the proper height before grazing or harvesting increases yields and quality of forage and pasture. Controlling weeds and clipping mature plants, where slopes allow, increase pasture yields. Using proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition. Because this soil erodes

easily, careful management is needed to avoid damaging the protective sod by overgrazing.

This soil is well suited to trees. The major limitation is steepness of slope. Hardwoods native to the area, such as northern red oak, are better suited than some other species. In places clearing of undesired stock in stands is essential to allow for replanting of preferred trees. Natural regeneration of hardwoods can be difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing improves the friability of the surface layer and maintains the spongelike mulch of leaves that absorbs large amounts of precipitation and runoff. This increases moisture for tree growth and improves natural regeneration underneath the existing forest canopy. In new plantings competing plants need to be controlled to allow for good growth. This can be accomplished through the careful use of herbicides or by girdling unwanted trees. Thinning at the proper times helps produce optimum growth. Care must be taken when harvesting trees to control erosion. Logging roads built on the contour where possible minimize runoff and the hazard of erosion.

Slope is the main limitation to the use of this soil as building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed in road construction. Roads need to be placed on the contour, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass VIe.

604—Huntsville-Beavercreek silt loams, channeled. This map unit consists of well drained, nearly level to sloping soils typically in the upper reaches of narrow valleys near intermittent and perennial streams. These soils are subject to occasional flooding. The meandering stream channel has divided the flood plain into many small irregular-shaped tracts. Areas are long and narrow and range from 5 to about 70 acres. They are made up of 50 to 70 percent Huntsville soils and 10 to 20 percent Beavercreek soils. Individual areas of these soils are so small or so intricately intermingled that to separate them in mapping was not practical.

Typically, the surface layer of a Huntsville soil is very dark grayish brown silt loam about 10 inches thick. The subsurface layer is black, friable silt loam in the upper part and very dark brown and very dark grayish brown, friable loam in the lower part. The subsoil to a depth of about 60 inches is dark grayish brown loam. In places the subsoil is sandy loam. Cobbly sandy loam is within a depth of 40 inches in places. In places small amounts of gravel are either in part of the soil or are throughout the soil.

Typically, the surface layer of a Beavercreek soil is very dark grayish brown silt loam about 7 inches thick. The underlying material is stratified dark brown, very dark grayish brown, and very dark brown cobbly loam, cobbly loamy sand, cobbly silt loam, and cobbly sandy loam. It extends to a depth of 60 inches or more. The surface in places is covered with as much as 80 percent cobbles and pebbles. In places the cobbly layers are below a depth of 25 inches.

Included with these soils in mapping are small areas of poorly drained Newalbin soils and poorly drained to very poorly drained Root soils. The Newalbin soils are silty and are typically on slightly lower positions. They make up 1 to 5 percent of mapped areas. The Root soils are cobbly and are just above the stream channels. They make up 1 to 10 percent of mapped areas.

Water and air move through the Huntsville soils at a moderate rate and through the Beavercreek soils at a moderately rapid rate. The available water capacity is very high in the Huntsville soils and low in the Beavercreek soils. Surface runoff is slow on the Huntsville soils and medium on the Beavercreek soils. The seasonal high water table is below a depth of 6 feet in both soils. The availability of phosphorus and potassium in the subsoil is medium in the Huntsville soils and low in the Beavercreek soils. The reaction is slightly acid or neutral in the Huntsville soils and slightly acid through mildly alkaline in the Beavercreek soils. The content of organic matter in the surface layer is high in the Huntsville soils and moderately low in the Beavercreek soils. The rooting zone extends to a depth of 60 inches or more in the Huntsville soils. It is limited to a depth of 10 to 25 inches in the Beavercreek soils by the large amount of coarse textured material below this depth.

Most areas of these soils are used for permanent pasture. Some areas are used for woodland, and some are tilled, but fields are typically too small to use for row crops. Pasture is well suited. Most pasture is bluegrass and is fairly productive because of the very high available water capacity in the Huntsville soils. In most places deep channels prevent access to areas with tilling and seeding equipment. Accessible areas can be made more productive by seeding to deeper rooted legumes and grasses. Grasses respond well to nitrogen. Potassium is needed to maintain legume stands. Productive pasture can be maintained by controlled grazing to allow the soil to firm and plants to reach the proper grazing height. Using proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

This map unit is not generally suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse

textured fill material and providing adequate side ditches and culverts help to protect the roads from damage caused by flooding, low soil strength, and frost action.

This map unit is in capability subclass Vw.

605D2—La Farge silt loam, 12 to 20 percent slopes, eroded. This well drained, moderately steep to steep soil is on summits and side slopes of low ridges. The ridges extend from the very steep sides of nearby ridges. Slopes are short and mostly convex. Areas are irregular in shape and range from 3 to about 10 acres.

Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsoil is about 36 inches thick. The upper 26 inches is brown and dark yellowish brown, friable silt loam, and the lower part is light olive brown loam. The underlying material is olive brown and light olive brown sandstone. Most areas in pasture or woodland have not been eroded. Small, mainly concave, areas are silty to a depth of more than 40 inches.

Included with this soil in mapping are small areas of well drained Norden soils. The Norden soils have a thinner silty mantle. They are on the most convex parts and make up 2 to 10 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is moderate. Surface runoff is rapid. In the subsoil the availability of phosphorus is high and potassium is low. The content of organic matter in the surface layer is moderately low. The soil is slightly acid through strongly acid. The rooting zone extends to the depth of the sandstone. The water table is below a depth of 6 feet in all seasons. This soil warms and dries early in the growing season. It is easy to till and can be tilled through a moderately wide range of soil moisture. This soil is easily eroded. The surface layer of a tilled soil puddles during rains and crusts upon drying. The crusting lowers further intake of air and water. A friable surface layer is difficult to maintain.

Most areas of this soil are used for cropland. Some areas are used for pasture or woodland. Corn, alfalfa-grass forage, and small grain are the main crops. Suitability is poor for row crops, such as corn, and is fair for small grain. Crops suffer somewhat from insufficient moisture in years when rainfall distribution is poor. The major limitation to using this soil for row crops is the hazard of erosion. Erosion can be controlled if row crops are grown only occasionally and in combination with hay crops. Growing forage crops and corn in alternating strips on the contour is well suited to this soil. Tillage methods that leave a large amount of crop residue on the surface are well suited to reducing soil loss. These practices along with applications of manure reduce crusting, increase intake of air and water, and improve fertility. This soil develops gullies easily. Gullies can be repaired and prevented by shaping, reseeding, and maintaining water courses as grassed waterways.

This soil is well suited to forage crops and pasture. Suitable plant varieties, maintaining a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer. Potassium is needed to maintain stands of legumes. Many areas of pasture are in bluegrass, and production can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

This soil is well suited to woodland. In places removal of undesired stock is necessary to allow for planting of preferred trees. Natural regeneration of hardwoods can be difficult because of the destruction of seeds and seedlings by rodents, insects, deer, and livestock. Elimination of grazing helps increase the spongelike cover of leaves that absorbs large amounts of precipitation and runoff and increases the moisture available for the tree growth. Plant competition in new plantings should be controlled to allow favorable growth. This can be done through the careful use of herbicides. Thinning at the proper time helps produce optimum growth. Access roads constructed on the contour help reduce erosion during harvesting operations.

Slope is the main limitation to the use of this soil for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. Roads need to be constructed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Land shaping and installing distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields. Bedrock hinders installation operations in some areas.

This soil is in capability subclass IVe.

606—Shiloh silty clay, ponded. This very poorly drained, level soil is in depressions along the Mississippi River flood plain. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to more than 100 acres.

Typically, the surface layer is very dark gray, mottled silty clay about 16 inches thick. The subsurface layer is black, mottled, firm silty clay loam to a depth of 25 inches. The underlying material to a depth of about 60 inches is very dark gray, mottled, firm silty clay loam.

Included with this soil in mapping are small areas underlain by sand or loamy sand at a depth of less than 60 inches. They are in positions similar to those of this Shiloh soil and make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a slow rate. The available water capacity is high, and surface runoff is ponded. The availability of phosphorus and potassium in the subsurface layer is medium. The subsurface layer is neutral or mildly alkaline. The content of organic matter in the surface layer is high. The seasonal high water table is above a depth of 2 feet. The rooting zone extends to the depth of the water table, except for water-tolerant plants.

Most areas of this soil are in wildlife refuge and support such marsh vegetation as reeds, sedges, and rushes. The areas are near open water and provide cover and food for waterfowl and other wildlife. This soil is poorly suited to row crops, hay, pasture, and trees because of wetness.

This soil is generally not suitable for building sites and septic tank absorption fields because of the flooding and ponding hazards. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help to protect the roads from damage caused by flooding, ponding, and low soil strength.

This soil is in capability subclass VIIIw.

608—Rawles silt loam, occasionally flooded. This moderately well drained level soil is on terraces. It is subject to occasional, brief flooding. Slopes are nearly plane. Narrow drainageways 1 to 4 feet deep meander across areas in many places. Areas are irregular in shape and range from 5 to about 40 acres.

Typically, the surface layer is very dark gray, calcareous silt loam about 9 inches thick. Next is stratified, multicolored, calcareous silt loam to a depth of about 41 inches. Below this is a very dark gray silty clay loam buried soil that is underlain by stratified, black and very dark gray silt loam to a depth of about 60 inches. In many places this soil is well drained or somewhat poorly drained. The surface layer is fine sandy loam in places. Sand is within a depth of 40 inches in places.

Included with this soil in mapping are small areas of well drained Terril soils, moderately well drained Minneiska soils, and poorly drained Moundprairie soils. The Terril soils contain more sand than this Rawles soil and are on slightly elevated positions. The Minneiska soils contain less clay and are on positions similar to those of the Rawles soil. The Moundprairie soils are in shallow drainageways. The included soils make up 5 to 15 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is high. Surface runoff is slow. In the subsoil the availability of phosphorus is low to high and potassium is low to medium. This soil is mildly alkaline or moderately alkaline throughout. The content of organic matter in the surface layer is moderate to high. The water table is below a depth of 6 feet. The rooting zone extends to a depth of 40 inches or more. This soil warms and dries fairly early in spring. It is moderately easy to till. The range in soil moisture suitable for tillage is moderately wide.

Nearly all areas of this soil are used for row crops. Corn and soybeans are well suited to this soil. These crops can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. In some years crops can be damaged or planting can be delayed by flooding.

This soil contains an excess of lime that can cause a nutrient imbalance. To overcome this imbalance, the soil requires liberal applications of phosphorus and potassium and additions of magnesium. A friable surface layer can be maintained by working the soil at the proper moisture for tillage and returning a large amount of residue to the soil. Minimum tillage methods, such as chisel plowing, help increase the intake of water.

A few areas of this soil are used for forage crops and pasture. This soil is well suited to these uses. Flooding damages legumes in some years. Nutrient deficiencies relating to excess lime can reduce yields. Corrective applications of nutrients may be needed. Using suitable plant varieties and the proper kinds and amounts of fertilizer increase yields of both forage and pasture. Harvesting at the proper stage of growth increases forage quality and palatability. Pasture productivity can be increased by allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

This soil is not generally used for woodland but is well suited to trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help to protect the roads from damage caused by flooding, low soil strength, and frost action.

This soil is in capability subclass IIw.

879B—Newalbin-Palms complex, 2 to 8 percent slopes. This map unit consists of very poorly drained, gently sloping Newalbin soils and very poorly drained, nearly level to sloping Palms soils along the upper reaches of narrow valleys. Areas are irregular in shape

and range from 3 to about 10 acres. They are about 50 to 80 percent Newalbin soils and 10 to 40 percent Palms soils. The Newalbin soils are commonly on alluvial fans at the mouth of small drainageways. The Palms soils are on higher elevations and are protected from alluvial deposition. They are hummocky. Individual areas of these soils are so small or closely intermingled that to separate them in mapping was not practical. Areas of this map unit are subject to occasional, very brief flooding. Some areas are subject to ponding during a part of the year.

Typically, the surface layer and underlying material of a Newalbin soil are dark grayish brown, very friable silt loam to a depth of about 43 inches. They contain thin strata of grayish brown and light brownish gray. Below this is black muck to a depth of about 60 inches. In places the muck layer is not present.

Typically, the surface layer and subsoil of a Palms soil are black muck about 10 inches thick. The next layer is very dark brown and black muck about 25 inches thick. The underlying material to a depth of about 60 inches is black silt loam. The muck layer is 6 to 7 feet thick in a few areas. In some areas a layer of silty alluvium 10 to 20 inches thick overlies the muck. The muck layer contains free lime in a few places.

Included with these soils in mapping are small areas of poorly drained Kalmarville soils and poorly drained and very poorly drained Root soils. The Kalmarville soils contain more sand than the major soils. They are along the streambanks and make up 1 to 2 percent of mapped areas. The Root soils have a cobbly subsoil. They are near the stream channel and make up 1 to 5 percent of mapped areas.

Water and air move through the Newalbin soils at a moderately slow rate and through the Palms soils at a moderate rate. The available water capacity of both soils is very high. Surface runoff is slow or very slow. The availability of phosphorus is high and potassium is medium in the underlying material of the Newalbin soils. The availability of phosphorus and potassium is low for Palms soils. The surface layer and underlying layers are neutral or slightly acid in the Newalbin soils and slightly acid through mildly alkaline in the Palms soils. The content of organic matter in the surface layer of the Newalbin soils is moderately low and is very high in the surface layer of the Palms soils. The water table is at or within a depth of 2 1/2 feet for the Newalbin soils and 1 foot for the Palms soils. The rooting zone is restricted by the depth to the water table.

Most areas of this map unit are used for bluegrass pasture and are well suited to this use. The very poorly drained muck soils support reeds and sedges and other plants that produce poor quality forage for livestock. These soils are difficult to renovate, fertilize, and clip. Bluegrass grows well on the Newalbin soils because adequate moisture is available throughout the growing season. Pasture can be maintained in good condition by allowing the soils to become firm and plants to reach the proper height before grazing. Some areas can be improved for pasture by removing brush and trees. Controlling livestock numbers and rotating pasture improve forage utilization and help maintain the sod in good condition.

These soils are generally not suitable for building sites and septic tank absorption fields because of the flooding and ponding hazards. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help to protect the roads from damage caused by flooding, ponding, and frost action.

This map unit is in capability subclass Vw.

1010—Riverwash. This map unit consists of somewhat poorly drained, nearly level to gently sloping, very rapidly permeable sediment along the channels of the Root and Mississippi Rivers. It is mostly on narrow sandbars that typically are 2 to 5 feet above the water level. The bars shift position as the stream channel continually alters its course. Areas are irregular in shape and range from 3 to about 10 acres. They are frequently to occasionally flooded. Slope ranges from 0 to 6 percent.

Riverwash mainly is loose brown sand to a depth of about 60 inches. In some areas small amounts of gravel are scattered throughout or there are gravelly layers. Some areas have thin loamy layers. A few areas consist of sand dredged from the Mississippi River.

Included with this unit in mapping are small areas of poorly drained Comfrey soils along the Mississippi River. They are loamy and typically are further from the channel. The included soils make up 2 to 5 percent of mapped areas.

Water and air move through Riverwash at a very rapid rate. The available water capacity is very low. Surface runoff is slow. The availability of phosphorus and potassium in the subsoil is low. The reaction throughout is neutral or mildly alkaline. The organic matter content in the surface layer is very low. The water table is at a depth of 2 to 5 feet during periods of high water in the river channel. The rooting zone is influenced by the depth to the water table.

The very low available water capacity, inaccessibility, instability, and flooding hazard limit the use of areas to open space and recreational uses. Along the Mississippi River, the drier areas are commonly used by boaters as campsites.

Areas of this map unit are generally not suitable for cropland, pasture, and woodland. Also, they are generally not suitable for building site development, local

roads, and septic tank absorption fields. Most areas support a sparse growth of prairie grasses, willow, and bushy plants or have no plant cover because of recent deposition.

This map unit is not assigned to a capability subclass.

1013—Pits, quarries. This map unit consists of open pits that have been excavated by removal of bedrock. The pits are about 10 to 75 feet deep. Areas are irregular in shape and are about 2 to 10 acres. This unit is mainly in areas of Etter, Frankville, Lacrescent, and Lamoille soils.

Typically, the soils in these areas have been removed or altered. Most of the pits are a source of limestone quarried for road surfacing material. Some of the limestone is quarried for agricultural limestone. Near Caledonia a quarry is in the St. Peter sandstone. A few pits are in the Franconia Formation. The sandstone is soft and is used for roadfill.

Included with this unit in mapping are adjoining areas of soils that have been altered by partial removal, by mixing, or by additions of stockpiled materials.

Some pits have been abandoned and are partially revegetated by grass, brush, and a few trees. Most areas are left idle. Onsite investigations are needed to determine the suitability of areas for most uses.

This map unit is not assigned to a capability subclass.

1016—Udorthents, loamy. These nearly level to moderately steep soils are in areas of cutting and filling for roads, housing developments, recreation areas, and similar uses. In areas where the soil material has been removed, the remaining material, typically, is similar to the subsoil or substratum of the adjacent soils. In filled areas or disposal areas the characteristics of the soil material are more varied. Typically, these areas consist of the subsoil and substratum material from nearby soils. Slopes are very complex and range from 2 to 20 percent. Most areas are irregular in shape and range from 3 to about 15 acres with a few areas as large as 100 acres.

Typically, to a depth of 60 inches these soils are dark yellowish brown or olive brown silt loam. Some areas are mainly sandy material.

Included with these soils in mapping are areas of sanitary landfill. Also, some areas are filled by bricks, glass, broken concrete, and other building materials. Sanitary landfill areas commonly have a covering of soil material and are planted to grasses.

The permeability, runoff rate, and organic matter content are variable. The available water capacity is variable but is dominantly moderate to high. The reaction is typically slightly acid through strongly acid, but some places are mildly alkaline. Some areas have a seasonal high water table, particularly the low lying areas. Depth of the rooting zone is variable. Tilth is poor. Hard rains tend to seal the surface in poorly vegetated areas, thus reducing the infiltration rate and restricting the emergence and growth of plants.

These soils in most places are suited to trees. In areas where the surface is bare, suitable plant cover is needed to control erosion.

This map unit is too variable to evaluate as a site for buildings, roads, and septic tank absorption fields. Onsite investigations are needed to determine the potential and limitation of areas for proposed uses.

These soils are not assigned to a capability subclass.

1812—Terril loam, sandy substratum. This moderately well drained, nearly level to gently sloping soil is on slightly elevated positions along the Root River valley. This soil is subject to rare flooding. Slopes are slightly convex or plane. Areas are irregular in shape and range from 5 to about 25 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black, very dark brown, and very dark grayish brown loam about 28 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown loam, and the lower part is brown loamy sand. The underlying material is stratified, brown and black sand to a depth of about 60 inches. In places the dark surface layer is less than 24 inches thick. Some small areas are somewhat poorly drained. In places the surface layer is sandy loam.

Included with this soil in mapping are small areas of poorly drained Comfrey soils. The Comfrey soils are loamy throughout. They are in narrow drains and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is high. Surface runoff is medium. In the subsoil the availability of phosphorus is high or very high and potassium is low. The subsoil is slightly acid or neutral. The content of organic matter in the surface layer is high. The water table is below a depth of 6 feet. The rooting zone extends to a depth of 60 inches or more. This soil warms early in the growing season and is easy to till.

Nearly all areas of this soil are used for cropland and are well suited to this use. Corn, soybeans, small grain, and forage crops are mainly grown. Floodwater generally recedes before crops are planted, and fields are not damaged because floods are of short duration. Row crops can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. The surface layer can be maintained in a friable condition by working the soil within the proper range of soil moisture, keeping tillage to a minimum, and returning a large amount of crop residue.

This soil is well suited to forage crops and pasture. Suitable varieties, a proper supply of nutrients, and harvesting at the proper stage of growth increase the yields and quality of forage crops. Forage crops and pasture respond well to lime and fertilizer. Potassium is needed to maintain stands of legumes. A few mostly

irregular-shaped areas are used for pasture. Most pasture is bluegrass. The pasture in many of these areas can be improved by seeding to more productive species. Allowing plants to reach the proper height before grazing, controlling weeds, and clipping mature plants maximize yields of forage. Proper stocking rates and rotation of pasture utilize the forage efficiently and maintain the sod in good condition.

This soil is not generally used for woodland but is well suited to trees. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is generally not suitable for building site development because of the rare flooding hazard. Soils that are better suited to this use are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help to protect the roads from damage caused by flooding, low soil strength, and frost action. This soil is suitable for use as septic tank absorption fields.

This soil is in capability class I.

1822B—Abscota Variant sand, 2 to 6 percent slopes. This well drained and moderately well drained, gently sloping soil is in valleys. It typically is on fans at the mouth of drainageways and on foot slopes below the steep to very steep sides of terraces. This soil is subject to occasional flooding. Slopes are plane to concave. Areas are mostly fan-shaped and range from 2 to about 8 acres.

Typically, the surface layer is very dark grayish brown sand about 3 inches thick. The underlying material to a depth of about 60 inches is stratified grayish brown, brown, and pale brown sand and loamy sand that has thin laminations of very dark grayish brown and dark grayish brown fine sandy loam, very fine sandy loam, loam, and silt loam. In a few places the soil is dominantly loamy or silty. In places a buried soil is at a depth of 20 to 60 inches. The buried soil is silty or loamy and extends to a depth of 60 inches or more.

Included with this soil in mapping are small areas of poorly drained sandy, loamy, and silty soils. These soils, some of which have a black surface layer, are in depressions and make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a rapid rate. Runoff is slow. The available water capacity, the availability of potassium and phosphorus in the subsoil, and the content of organic matter in the surface layer are low. The soil is neutral or mildly alkaline throughout. The seasonal high water table is at a depth of 3 to 6 feet. The rooting zone extends to a depth of 40 inches or more. Most areas of this soil warm and dry early in the growing season. This soil is easy to till and can be tilled through a wide range of soil moisture.

Areas of this soil are used mainly for pasture where they are not protected from flooding or deposition of sand or where the larger areas of adjacent soils are poorly suited to cropland. This soil has fair suitability for pasture and hayland. Low available water capacity and fertility are the main limitations. Bluegrass is not generally productive on this soil because of its shallow root system. Deeper rooted plants, such as legumes, bromegrass, orchardgrass, and timothy, are better suited than bluegrass to this soil because they can obtain moisture from the underlying material. The application of nitrogen is essential for good grass production on this soil. Grazing management, proper stocking rates, and control of weeds help keep the pasture in good condition. Clearing of brush is needed to improve pasture in places. Where grazing management is practical, rotation of pasture and proper stocking rates utilize the forage efficiently and maintain the sod in good condition.

Some areas of this soil are used for cropland. They are suited to corn, soybeans, small grain, and to grasses and legumes for hay and pasture. Areas are small and typically managed with nearby soils. Most areas used for cropland are below steep to very steep terrace side slopes. Low available water capacity, low fertility, and flooding are the limitations for row crops, such as corn. Crop yields are variable on this soil because of the varying thickness of sandy sediment overlying the loamy material that has higher fertility and higher available moisture capacity. Application of fertilizers, particularly nitrogen, is needed for good corn yields. Many areas of this soil are subject to occasional flooding and the deposition of sandy sediment from gullies upslope within the terrace side slopes. Development of an unobstructed channel and diking of the channel help prevent flooding. The deposition of sediment can be controlled or lessened by stabilizing the gullies and steep terrace side slopes with suitable plant cover, such as crownvetch or plantings of pine. Erosion is a hazard in places. Erosion can be controlled in most places by farming across the slope, returning a large amount of crop residue, and applying a large amount of manure to the soil.

A few areas of this soil are in unmanaged woodland. Eastern cottonwood is the main species. This soil in most places is better suited to conifers, such as red and white pine, than to many other species. Young seedlings can be damaged by flooding and deposition in places. In most places removal of brush and undesirable species is needed to reduce competition to young seedlings. Small areas of poorly drained soils included with this soil are too wet for conifers and are better suited to species, such as eastern cottonwood and green ash.

This soil is generally not suitable for building site development because of the flooding hazard. Soils that are better suited to this use are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding. This soil is generally not suitable for use as septic tank

absorption fields because of flooding and wetness and because it does not adequately filter the effluent. Soils that are better suited to this use are generally nearby.

This soil is in capability subclass IIIs.

1830—Eitzen silt loam, occasionally flooded. This well drained and moderately well drained, nearly level soil is in broad drainageways below ridgetops. The drainageways are long and commonly more than 200 feet across. Areas are elongated and range from 5 to about 20 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. Next is about 17 inches of stratified, very dark grayish brown silt loam. Below this is a buried soil. The upper 23 inches is very dark brown and very dark grayish brown silt loam, and the lower part to a depth of about 60 inches is dark yellowish brown and yellowish loam. In places the upper part of the surface layer is dark grayish brown. In places the dark grayish brown surface layer is less than 20 inches thick. A few small areas have a black surface layer 20 to 40 inches thick. Some small areas are somewhat poorly drained.

Included with this soil in mapping are small areas of Lindstrom soils. The Lindstrom soils are deep and silty. They are upslope along the edges or at the heads of drainageways and make up about 5 to 10 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is medium. The upper part of the soil is medium acid through neutral, and the buried subsoil is slightly acid through strongly acid. The content of organic matter in the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more. This soil warms and dries early in the growing season. It is moderately easy to till and can be worked through a wide range of soil moisture. The surface soil is easy to maintain in a friable condition.

Areas of this soil are mainly used for cropland. Row crops are well suited. Other crops are small grain, forage, and pasture. Most areas are used for corn. Corn and soybeans can be grown satisfactorily every year if fertility is maintained and weeds, insects, and diseases are controlled. Crops are damaged by flooding in some years. In places the flood hazard can be reduced by widening and deepening the drainageway or floodway (fig. 13). In some areas dams at the head of drainageways protect this soil from flooding. Returning crop residue and applying manure help maintain a friable surface. This soil is suited to plowing or to tillage methods that leave crop residue on the surface. Areas where water concentrates need to be maintained as grassed waterways to prevent gullies from developing.

Few areas of this soil are used for pasture or hay crops and are well suited to these uses. A proper nutrient supply, suitable plant varieties, and harvesting at the proper stage of growth maximize yields and quality of forage and pasture. Pasture yields can be increased by allowing plants to reach the proper height before grazing. Clipping mature plants and controlling weeds increase the number of productive plants. Proper stocking rates and rotating pasture utilize forage efficiently and maintain the sod in good condition.

This soil is well suited to trees but is not normally used for woodland. Tree seeds and seedlings survive and grow well if competing vegetation is controlled or removed.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help to protect the roads from damage caused by flooding, low soil strength, and frost action.

This soil is in capability subclass IIw.

1838—Colo silt loam, overwash. This poorly drained, nearly level soil is in major river valleys. It is subject to occasional flooding, generally early in spring. Narrow, shallow drains cross this soil. Areas are mostly elongated and range from 5 to about 25 acres.

Typically, the surface layer is very dark gray, calcareous silt loam about 8 inches thick. The next layer is very dark gray, mottled, calcareous silty clay loam about 5 inches thick. The underlying material is a buried soil and extends to a depth of about 60 inches. The upper part is black silty clay loam, and the lower part is very dark gray silty clay loam. In some areas the calcareous surface layer is as much as 30 inches thick. In a few places the soil is loam throughout. Small areas are underlain by sand within a depth of 40 inches. In a few places this soil is somewhat poorly drained.

Air and water move through this soil at a moderate rate. The available water capacity is high. Surface runoff is slow. The availability of phosphorus and potassium in the subsoil is medium. The content of organic matter in the surface layer is moderate to high. The upper part of the soil is mildly alkaline, and the lower part is neutral or slightly acid. The water table is at a depth of 1 to 3 feet during periods when the river level is high. The rooting zone is restricted by the depth to the water table. This soil warms and dries slowly in spring. It is moderately difficult to till. The range in content of soil moisture suitable for tillage is moderately narrow. Working this soil when it is too wet causes hard clods to form when the soil dries.

Most areas of this soil are used for row crops. The suitability is fair for corn and soybeans. Corn is the most commonly grown crop. The main limitations to the use of this soil for these crops are wetness and flooding. This

Figure 13.—An area of Eitzen silt loam, occasionally flooded. The grassed waterway provides a stable channel that prevents floodwater from flowing across the field.

soil in many places is difficult to drain with tile because no suitable outlet is available. The soil is very productive where it can be drained and protected from flooding. The drained soil warms and dries earlier in spring. This allows for tillage within the proper range of soil moisture and improves friability of the surface layer. Returning crop residue to the soil and keeping tillage to a minimum help maintain a friable surface and increase intake of air and water. If this soil is properly drained, row crops can be grown satisfactorily every year, if fertility is maintained and weeds, insects, and diseases are controlled.

Areas too wet for cropland are well suited to pasture because of the abundance of available moisture. Bluegrass grows well, but bromegrass and Garrison creeping foxtail are more productive. Nitrogen is needed for good grass pasture production. Because of wetness and flooding, legume stands are hard to maintain. Pasture can be maintained in good condition if the soil is allowed to firm in spring and other wet periods before grazing and if plants are allowed to reach the proper height. An adequate nutrient supply, clipping mature plants, and control of weeds maximize production. Lime is not needed for pasture plants on this soil. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Some areas of this soil are in woodland that is grazed. This soil is poorly suited to woodland. The main limitation is wetness, which restricts the choice of species. Trees adaptable to wet conditions are needed. Management of this soil for woodland includes elimination of grazing and removal of undesirable species. Plant competition is severe in new plantings but can be overcome by controlled spraying or by cultivation and removal of undesirable species.

This soil is generally not suitable for building sites and septic tank absorption fields because of the flooding hazard and seasonal high water table. Also, structures can be damaged from the shrinking and swelling of the soil with changes in moisture content. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help to protect the roads from damage caused by flooding, low soil strength, and frost action.

This soil is in capability subclass IIw.

1847—Kalmarville fine sandy loam, channeled. This poorly drained, level soil is in narrow valleys that are subject to frequent flooding. The shallow creeks meandering through areas of this soil divide it into small irregular-shaped tracts. Areas are long and narrow and range from 2 to about 20 acres.

Typically, the surface layer consists of fine strata of very dark grayish brown, very dark gray, dark gray, and grayish brown, mottled fine sandy loam and silt loam about 20 inches thick. The upper 26 inches of the underlying material is stratified dark gray, gray, and grayish brown sand, fine sand, fine sandy loam, loam, and silt loam. The lower part to a depth of about 60 inches is a buried soil. It is black loam over very dark gray loamy sand. In places the underlying material has a small amount of gravel.

Included with this soil in mapping are small areas of Riverwash and poorly drained Comfrey, Newalbin, and Root soils. The Riverwash consists of recently deposited mounds of sand and makes up about 3 to 8 percent of mapped areas. The Newalbin soils are silty throughout. The Comfrey soils have a dark colored surface layer and are loamy. The Comfrey and Newalbin soils are in low areas away from the channel, and each makes up 1 to 2 percent of mapped areas. The Root soils are cobbly. They are typically near stream channels and make up less than 1 percent of mapped areas.

Water and air move through the upper part of the soil at a moderately rapid rate and through the lower part at a rapid rate. The available water capacity is moderate, and surface runoff is slow. The content of organic matter in the surface layer is moderate. The availability of phosphorus and potassium in the underlying material is medium. The soil is neutral or mildly alkaline throughout. The rooting zone is restricted because of the seasonal high water table within a depth of 1 foot.

Most areas of this soil are in bluegrass pasture because of frequent flooding and stream dissection. Some areas are used for woodland. Suitability is fair for pasture. Most areas do not have access for farm machinery. This soil is firm through a wide range of soil moisture, but grazing may need to be deferred during very wet periods to prevent damage to the pasture. Controlling weeds is a management concern because of infestations from recurring floods. Pasture can be maintained in a good condition by allowing plants to reach the proper height before grazing. Rotating pasture and using proper stocking rates utilize forage efficiently and maintain the sod in good condition.

Some areas of this soil are in woodland. This soil is poorly suited to woodland. The main limitation is wetness, which restricts the choice of species. Trees adaptable to wetness are desirable. Management of this soil for woodland includes elimination of grazing and removal of undesirable species. Plant competition is severe in new plantings but can be overcome by controlled spraying or by cultivation and removal of undesirable trees.

This soil is generally not suitable for building sites and septic tank absorption fields because of the flooding hazard and seasonal high water table. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, well compacted, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding, soil wetness, and frost action.

This soil is in capability subclass Vw.

1856D—Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes. This somewhat excessively drained, moderately steep to steep soil is on foot slopes. Slopes are slightly convex to concave. Areas are elongated and range from 3 to about 10 acres.

Typically, the surface layer is very dark brown loamy fine sand about 9 inches thick. The subsurface layer is very dark brown and very dark grayish brown loamy fine sand about 29 inches thick. The upper 50 inches of the subsoil is dark grayish brown and grayish brown, loose loamy fine sand, and the lower part is dark grayish brown and dark brown sandy loam and loam to a depth of about 60 inches. In places the loamy sand layer is less than 20 inches thick. Small areas have a surface layer of grayish brown fine sand. A few small areas are less sloping.

Included with this soil in mapping are small areas of well drained Eyota and Lindstrom soils. These soils are loamy in the upper part. They have plane and concave slopes and make up 1 to 10 percent of mapped areas.

Water and air move through the surface and subsurface layers and upper part of the subsoil at a rapid rate and through the lower part of the subsoil at a moderate rate. The available water capacity is low in the sandy mantle. The moisture supply to plants, however, is enhanced by the higher available water capacity of the loamy subsoil. Surface runoff is medium. The availability of subsoil phosphorus and potassium is low. The subsoil is slightly acid through very strongly acid in the upper part and slightly acid or medium acid in the lower part. The content of organic matter in the surface layer is moderately low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons. This soil warms and dries early in spring. It is very easy to till and dries soon after rains.

Most areas of this soil are used for cropland and pasture. Forages are the common crops, but corn and small grain are also grown. Row crops are poorly suited. The main limitations are the low available water capacity and severe erosion hazard. Erosion can be controlled by growing row crops in a combination with hay crops, farming on the contour, and using tillage practices that leave a large amount of crop residue on the surface.

Drainageways should be shaped, seeded, and maintained as grassed waterways. Full season crops, such as corn, suffer from drought unless summer rainfall is well distributed. Yields, plant populations, varieties, and fertilizer rates need to be adjusted to the limited moisture supply. This soil is well suited to early season crops, such as small grain, peas, and sweet corn, that can better utilize the available moisture in the early part of the growing season.

Forage crops and pasture are better suited to this soil than corn and soybeans because they are less dependent on summer rainfall. They also protect the soil from erosion. Areas in pasture commonly are managed with the dominant nearby soil. Pasture production is low during the warm summer unless rainfall is timely. Deep-rooted crops, such as alfalfa and bromegrass, are better suited than bluegrass because their root systems can better obtain moisture from the subsoil and underlying material. Applications of nutrients, such as nitrogen and potassium, several times during the growing season minimize losses from leaching. Grazing management is needed for good utilization of forage. This management includes delay of grazing until pasture plants are at the recommended height for grazing, proper stocking rates, rotation of pasture, control of weeds, and clipping mature plants.

This soil has fair suitability for woodland and plantings for wildlife cover. Competing vegetation in new plantings should be controlled or removed. This can be accomplished by tillage methods, careful spraying with herbicides, and removal of less desirable trees by cutting or girdling.

Slope is the main limitation to the use of this soil for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed for construction of roads. Roads need to be placed on the contour, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. This soil is poorly suited to septic tank absorption fields because of the steepness of slope and because the soil does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible and placing them across the slope help to lessen the severity of the slope limitation and pollution hazard, but additional precautionary measures are necessary in some areas.

This soil is in capability subclass VIs.

1856E—Plainfield loamy fine sand, loamy substratum, 25 to 50 percent slopes. This somewhat excessively drained, very steep soil is on foot slopes below sides of ridges. Slopes are mostly concave or plane. Areas are elongated and range from 2 to about 45 acres.

Typically, the surface layer is dark grayish brown loamy fine sand about 7 inches thick. The subsoil is about 53 inches thick. The upper part is brown and dark yellowish brown loamy fine sand, the middle part is yellowish brown fine sandy loam, and the lower part is yellowish brown and light olive brown loam to a depth of about 60 inches. Small eroded areas, mostly on convex positions, have a brown surface layer. A few areas contain as much as 30 percent limestone cobbles and flags on and within the soil.

Included with this soil in mapping are small areas of well drained Council and Eyota soils. These soils have a loamy mantle and are on positions similar to those of this Plainfield soil. The Council soil makes up about 2 to 5 percent of mapped areas, and the Eyota soil makes up about 1 to 2 percent.

Water and air move through the surface layer and the upper part of the subsoil at a rapid rate and in the lower part of the subsoil at a moderate rate. Surface runoff is medium to rapid. The available water capacity is low in the upper sandy mantle. The moisture supply to plants, however, is enhanced by the higher available water capacity of the loamy subsoil. The availability of phosphorus and potassium in the subsoil is low. The subsoil is slightly acid through very strongly acid in the upper part and slightly acid or medium acid in the lower part. The content of organic matter in the surface layer is low. The rooting zone extends to a depth of 60 inches or more. The water table is below a depth of 6 feet in all seasons.

Most areas of this soil are used for pasture. Many areas are in brush and thin stands of stunted oaks and birch. This soil is not suited to cropland. It is poorly suited to pasture. Slopes are too steep for the safe operation of farm equipment. Productivity of the existing bluegrass is low because of the generally warm southerly exposure and limited moisture supply. Gullies have formed in this soil in places. Gullies develop easily and are difficult to stabilize.

This soil has fair suitability for woodland and plantings for wildlife cover. Slopes are too steep to plant seedlings with mechanical equipment. Competing vegetation in new plantings needs to be controlled or removed. This can be accomplished by prescribed burning, spraying with herbicides, and girdling or removal of less desirable trees by cutting.

Slope is the main limitation for the use of this soil as building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Large amounts of cutting and filling are generally needed

in the construction of roads. Roads need to be placed on the contour, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. This soil is poorly suited to septic tank absorption fields because of the steepness of slope and because the soil does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water supplies. Installing distribution lines as close to the surface as possible and placing them across the slope help to lessen the severity of the slope limitation and pollution hazard, but additional precautionary measures are necessary in some areas.

This soil is in capability subclass VIIe.

1857B—Eitzen silt loam, 1 to 6 percent slopes, channeled. This gently sloping, well drained and moderately well drained soil is in drainageways in the upper reaches of narrow valleys near the tops of ridges. These meandering drainageways are commonly less than 200 feet across. This soil is subject to occasional, very brief flooding. Areas are long and narrow and range from 5 to about 20 acres.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The next layer is stratified, very dark grayish brown and very dark brown, very friable silt loam about 22 inches thick. The underlying material is a buried soil. The upper part is black, friable silt loam about 15 inches thick, and the lower part to a depth of about 72 inches is very dark brown and very dark grayish brown, mottled, friable silt loam. In places the surface layer is dark grayish brown, and it is less than 20 inches thick in places. A few small areas have a black surface layer 20 to 40 inches thick. A few small areas are moderately well drained.

Included with this soil in mapping are small areas of well drained Mt. Carroll and Port Byron soils. These soils are silty. They are upslope along the edges of the drainageways that are not subject to flooding. The included soils make up 5 to 10 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high, and surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is medium. The surface layer is medium acid through neutral, and the buried subsoil is slightly acid through strongly acid. The content of organic matter in the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more.

Most areas of this unit consist of drainageways that are too narrow to crop and are maintained as grassed waterways. Some areas contain gullies that dissect the soil into patches too small to farm. Many areas are used for bluegrass pasture along with the steep adjacent soils. Pasture is well suited. Most areas are managed with the soils on the nearby slopes. The bluegrass pasture can be improved by fertilizing and planting areas to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize forage production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Where areas are not occupied by waterways or dissected by gullies, they are used for cropland. Filling gullies and shaping, seeding, and maintaining them as grassed waterways prevent further gully erosion and allow the broader valleys to be used for row crops. Row crops are well suited to these soils if gully erosion is controlled. Very brief flooding can damage crops in some seasons.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help to protect the roads from damage caused by flooding, low soil strength, and frost action.

This soil is in capability subclass Vw.

1858F—Timula-Lamont complex, 40 to 70 percent slopes. This map unit consists of very steep, well drained soils on short terrace side slopes. Slopes are convex. Areas are long and narrow and range from 3 to about 10 acres. They are about 65 to 80 percent Timula soils and 10 to 20 percent Lamont soils. The Timula soils are typically on the upper part of the slope, and the Lamont soils are mainly on the lower part. Gullies cross these soils in many places. Individual areas of these soils are so closely intermingled or so small that to separate them in mapping was not practical.

Typically, a Timula soil has a very dark grayish brown silt loam surface layer about 10 inches thick. The subsoil is dark yellowish brown silt loam. The underlying material is light olive brown, calcareous silt loam to a depth of about 60 inches. Many areas have free lime within a depth of 18 inches. In some areas the surface layer and material from the upper part of the subsoil have been mixed as a result of erosion.

Typically, a Lamont soil has a very dark grayish brown sandy loam surface layer about 9 inches thick. The subsoil is brown and yellowish brown fine sandy loam about 33 inches thick. The underlying material is yellowish brown and grayish brown, stratified fine sandy loam, silt loam, and sandy clay loam to a depth of about 60 inches. Small areas have a silt loam surface layer and subsoil. Strongly convex parts of the slope have been eroded, and the surface soil is dark brown.

Included with these soils in mapping are well drained Bertrand soils, moderately well drained and well drained Chaseburg soils, poorly drained Newalbin soils, and moderately well drained clayey soils. The Bertrand soils contain more clay than the major soils. They are on positions similar to those of the major soils and make up 2 to 5 percent of mapped areas. The Chaseburg and

Newalbin soils formed in stratified sediment and are in narrow drainageways. The Chaseburg soils make up about 1 to 2 percent of mapped areas and the Newalbin soils less than 1 percent. The well drained clayey soils are on similar positions. They make up 1 to 5 percent of mapped areas.

Water and air move through the Timula soils at a moderate rate and through the Lamont soils at a moderately rapid rate. The available water capacity is very high in the Timula soils and moderate in the Lamont soils. Surface runoff is very rapid. The subsoil of the Timula soils is neutral or slightly acid. The surface layer of the Lamont soils is medium acid or strongly acid, and the underlying material is medium acid through mildly alkaline. The availability of phosphorus in the subsoil is medium in both soils. The availability of potassium in the subsoil is medium or low in the Timula soils and low in the Lamont soils. The content of organic matter in the surface layer is low in the Lamont soils and moderately low in the Timula soils. The water table is below a depth of 6 feet in all seasons. The rooting zone extends to a depth of 60 inches or more.

Most areas of this map unit are in woodland and are pastured. They are generally not suitable for row crops and pasture because of the very steep slopes. Suitability is fair for woodland. Because areas of this map unit are generally small, they are generally not fenced and are grazed by livestock. Eliminating grazing allows new seedlings to develop and protects the spongelike cover of leaves that protect the soil. Woodlands can be further improved by removing undesirable species. Thinning at the proper time improves the growth rate. New plantings have severe competition from other vegetation. This can be controlled by spraying with herbicides or by cultivation. Slopes are short so there are no serious limitations for harvesting. Access is generally available from the more gentle sloping areas upslope and downslope.

These soils are generally not suitable for building sites, local roads, or septic tank absorption fields because of steepness of slope.

This map unit is in capability subclass VIIe.

1860—Comfrey silty clay loam, channeled. This poorly drained soil is on flood plains along the Mississippi River. It is on flats and narrrow ridges 1 to 4 feet above depressions and drainageways. It is dissected by stream channels and subject to frequent flooding. Areas are separated by bodies of water in many places. Slopes are less than 2 percent. Areas are irregular in shape and range from 10 to about 200 acres.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer is very dark gray and about 20 inches thick. The upper part is clay loam, and the lower part is loam. The underlying material to a depth of about 60 inches is mottled, dark gray and gray loam and fine sandy loam. Small areas are fine sandy loam below a depth of 40 inches and grade to loamy fine sand or fine sand as depth increases. In a few areas loamy fine sand is at a depth of less than 40 inches. Some areas have a silty surface.

Included with this soil in mapping are small areas of Riverwash and very poorly drained Shiloh soils. The Riverwash is on sandy natural levees and sandbars along stream channels and makes up less than 1 percent of mapped areas. The Shiloh soils are in clayey shallow depressions and make up about 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is high. Surface runoff is slow. The availability of phosphorus and potassium in the subsoil is high. The content of organic matter in the surface layer is high to very high. The upper part of the solum is neutral through strongly acid, and the lower part is slightly acid. The water table is at a depth of 1 foot to 3 feet during wet periods. The rooting zone is restricted to the upper 2 to 3 feet of soil.

This soil has poor suitability for cropland and pasture. The main limitations are flooding, a high water table, and lack of access.

Areas of this soil are generally not suitable for building sites and septic tank absorption fields because of the flooding hazard and seasonal high water table. Also, structures can be damaged because of low soil strength. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding, wetness, and low soil strength.

This soil is in capability subclass VIw.

1861B—Chaseburg silt loam, 2 to 6 percent slopes, channeled. This gently sloping, well drained and moderately well drained soil is along the upper reaches of narrow valleys, mainly below moderately steep to very steep slopes. Slopes are nearly plane. This soil is subject to frequent, very brief flooding. Some areas have gullies or channels as much as 6 feet in depth. Areas are long and narrow and range from 3 to about 20 acres.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The underlying material is stratified, dark grayish brown silt loam about 49 inches thick. Below this is a buried soil that is very dark grayish brown silt loam to a depth of 60 inches. In places the buried soil is at a depth of less than 40 inches. In a few areas cobbly loam or sandy loam is within a depth of 60 inches. In places the surface layer is very dark grayish brown. A few areas are somewhat poorly drained.

Included with this soil in mapping are small areas of well drained and moderately well drained Beavercreek soils and well drained Elbaville, Seaton, and Timula soils. The Beavercreek soils are cobbly and on fans at the heads of gullies. The Elbaville and Seaton soils contain more clay than this Chaseburg soil. The Timula soils

have a subsoil and are on steep to very steep terrace side slopes. The included soils each make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is medium. The availability of phosphorus is high and potassium is medium in the underlying material. The surface layer is neutral or slightly acid, and the underlying material is slightly acid or medium acid. The content of organic matter in the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. The rooting zone is below a depth of 60 inches.

Most areas of this soil are used for permanent pasture. The suitability is fair for this use. In most places deep channels prevent the use of farm machinery. The pasture is bluegrass, which grows well because of the very high available water capacity. Productive pasture can be maintained by delaying grazing in spring until the soil has firmed and the plants have reached the proper height for grazing. Proper stocking rates and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Some areas of this soil are in woodland. This soil is well suited to trees. In most places timber stands can be improved by removing undesirable species. This soil is well suited to black walnut and most other hardwoods. Weed control is needed to prevent undesirable vegetation from competing with new plantings.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, well compacted fill material and providing adequate side ditches and culverts help protect the roads from flooding and frost damage.

This soil is in capability subclass Vw.

1862—Zwingle Variant silty clay. This nearly level, poorly drained soil is on stream terraces. Slopes are plane. Areas are irregular in shape and range from 3 to about 20 acres.

Typically, the surface layer is dark gray silty clay about 6 inches thick. The subsoil is about 41 inches thick. The upper part is grayish brown clay, and the lower part is olive gray, pale olive, and reddish brown, mottled clay. The underlying material to a depth of about 60 inches is mottled, light olive gray and reddish brown, stratified silty clay, silty clay loam, and silt loam. Small areas are somewhat poorly drained. The surface layer is silt loam in a few places. A few small areas have slopes of 2 to 6 percent.

Included with this soil in mapping are small areas of well drained Festina soils and somewhat poorly drained clayey soils. The Festina soils contain more silt and less clay than this Zwingle Variant soil and are on positions similar to those of the Zwingle Variant soil. They make up 2 to 10 percent of mapped areas. The clayey soils are underlain by stratified sandy and loamy material within a depth of 30 to 60 inches. They are on similar positions and make up 2 to 5 percent of mapped areas.

Water and air move through this soil at a very slow rate. The available water capacity is moderate. Surface runoff is slow. The availability of phosphorus and potassium in the subsoil is medium. The subsoil is medium acid through very strongly acid. The content of organic matter in the surface layer is moderately low. The seasonal high water table is at a depth of 2 to 4 feet. The rooting zone extends to the water table and is restricted by the firm clayey subsoil. This soil warms and dries slowly in spring and is difficult to till. It commonly is worked when too wet. This compacts the soil, slows water absorption and air movement, and reduces nutrient availability.

Most areas of this soil are used for cropland or pasture. Legumes, grasses, corn, and small grain are the commonly grown crops. Suitability is fair for row crops. Wetness and a high content of clay in the surface layer limit productivity. Because the high content of clay restricts the movement of water, this soil is difficult to drain with tile. Close spacing of tile is needed, and tiling is not always successful. Shallow surface drains are beneficial in places to remove surface water. The level areas are suited to row crops year after year, but the surface layer is difficult to maintain in a friable condition. Friability of the surface layer can be improved by growing occasional forage crops, returning crop residue to the soil, and applying large amounts of manure. Fall plowing helps maintain soil tilth because of freezing and thawing during winter. In addition, the fall plowed soil warms and dries earlier in spring. A starter fertilizer is needed in the early part of the growing season to add needed nutrients to the soil.

Because this soil is difficult to use for cultivated crops, many areas are used for forage crops or pasture. It is poorly suited to most forage crops. Stands of alfalfa are difficult to maintain because of root rot associated with wetness. Water-tolerant legumes and grasses should be planted. Suitable species in pasture are productive if properly fertilized, limed, and managed. Legumes respond well to lime, and potassium is needed to maintain healthy stands. Delay of grazing in spring until the soil is firm, allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds increase productivity. In places pasture can be improved by removing brush. Using proper rates of stocking and rotation of pasture help to utilize forage efficiently and maintain the sod in good condition.

A few areas of this soil are in woodland. This soil is suited to trees, but trees tolerant of wetness should be selected for planting. The soil is poorly suited to most conifers. Plant competition is severe. Spraying with approved herbicides or cultivation helps to remove

competing plants. Existing woodlands can be improved by removing undesirable species.

Basements of buildings on this soil should be constructed above the seasonal high water table. Tile drains around foundations help to remove excess subsurface water. Landscaping needs to be designed to drain surface water away from buildings. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Roads need to be constructed on well compacted, coarse textured base material brought in from nearby soils or other areas. This helps protect the roads from damage resulting from the low strength of this soil and from the hazard of frost action. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table and because the permeability of this soil restricts it from readily absorbing effluent. In some areas a mound-type absorption field is suitable.

This soil is in capability subclass IIIw.

1885—Abscota loamy sand, occasionally flooded. This well drained and moderately well drained, nearly level to gently sloping soil is next to the channel of the Root River. It typically is along the outer curve of the channel where sediment spills over the bank when the river is at flood stage. This soil is subject to occasional flooding. Areas tend to be elongated and range from 5 to about 20 acres.

Typically, the surface layer is very dark gray loamy sand about 8 inches thick. The underlying material is light brownish gray, very dark grayish brown, and grayish brown, loose, calcareous sand to a depth of 60 inches. In many places a buried loamy soil is at a depth of 40 to 80 inches. In some areas the surface layer is black sandy loam. A few areas are somewhat poorly drained.

Included with this soil in mapping are poorly drained and somewhat poorly drained soils in narrow drainageways. These soils have a loamy or silty mantle and are underlain by sand at a depth of 20 to 40 inches. They make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a rapid rate. Surface runoff is slow. The available water capacity is low. The availability of phosphorus and potassium in the subsoil is low. The upper part of the subsoil is neutral or mildly alkaline, and the lower part is mildly alkaline. The organic matter content of the surface layer is low to moderately low. The seasonal high water table is at a depth of 2 to 5 feet. The rooting zone extends to a depth of 60 inches or more.

Most areas of this soil are used for pasture. This soil is suitable for pasture and hay crops, but production is low because of insufficient soil moisture during the warm, dry summer. Legumes are damaged by flooding in some years. Legumes and deep-rooted grasses, such as bromegrass, are more productive on this soil than bluegrass because they produce deeper roots to reach soil moisture. Grass pasture responds well to fertilizer, particularly nitrogen. Moderate amounts of fertilizer applied 2 or 3 times during the growing season minimize the leaching of nutrients. Lime is not needed on this soil. Allowing plants to develop to the proper height before grazing, controlling weeds, and clipping pasture increase yields of forage. Proper stocking rates and rotation of pasture utilize forage efficiently and maintain the pasture in good condition. In places removal of brush and trees is needed to improve pasture.

A few areas of this soil are used for cropland. Corn and soybeans are commonly grown crops but are poorly suited. The main limitations to using this soil for these crops are the low available water capacity and the hazard of flooding.

A few areas of this soil are in woodland, mostly eastern cottonwood and green ash. Young seedlings can be damaged by floods. In places removal of brush and undesirable species is needed to reduce competition to young seedlings.

This soil is generally not suitable for building site development because of the flooding hazard. It is not suitable for septic tank absorption fields because of flooding and soil wetness and because the soil does not adequately filter the effluent. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding.

This soil is in capability subclass IVs.

1886—Minneiska Variant loamy fine sand. This well drained and moderately well drained, nearly level soil is near the stream channel along the Root River. This soil is subject to occasional flooding. Most areas are dissected by meandering narrow drainageways. Areas are elongated and range from 3 to about 30 acres.

Typically, the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The underlying material is about 20 inches thick. It is stratified very dark grayish brown fine sand with thin layers of dark grayish brown and very dark grayish brown loamy fine sand, fine sandy loam, and silt loam. Below this to a depth of about 60 inches is a buried, black loam soil. Some areas do not have thin layers of finer textured material in the upper mantle. Small areas are underlain by loamy material at a depth of less than 20 inches or as much as 60 inches. A few areas are somewhat poorly drained.

Included with this soil in mapping are small areas of moderately well drained Minneiska and Rawles soils. The Minneiska soils are loamy, and the Rawles soils are silty. These soils typically are further from the channel than Minneiska Variant soils. They make up 2 to 10 percent of mapped areas.

Water and air move through this soil at a moderately rapid rate. Surface runoff is slow. The available water capacity is moderate. The availability of phosphorus and potassium in the underlying material is low or medium. The content of organic matter in the surface layer is low to moderately low. This soil is mildly alkaline throughout. The rooting zone extends to a depth of 60 inches. The water table is at a depth of 3 to 6 feet when the water level in the river is high. This soil warms and dries early in the growing season. It is very easy to till and can be tilled soon after rains.

This soil has fair suitability for row crops. Most areas of this soil are used for continuous cropping. Corn is the main crop, but small grain and forage crops are also grown. The major limitations to the use of this soil for row crops are flooding and insufficient moisture throughout the growing season. Dikes have been built in places to control flooding. Although the upper part of the soil is sandy and has low available water capacity, the supply of water to plants is improved by moderate available water capacity in the loamy underlying material. A good supply of nutrients, particularly nitrogen, increases production of corn. Plant populations, plant varieties, and application of nutrients need to be adjusted to the somewhat limited available water supply. Lime is not needed because it is provided by the lime enriched floodwater. In dry periods in spring, seedling mortality is increased. Sand blown by wind can damage young seedlings in some of the larger areas of this soil. Seed germination can be improved and wind erosion controlled by maintaining crop residue on the surface.

This soil has fair suitability for forage crops and for deep-rooted pasture plants. Forage crops take good advantage of seasonal rainfall, but legumes are difficult to maintain unless protected from flooding. A few areas are used for pasture. The production of bluegrass pasture is good early in the growing season if nutrients are supplied. During the warm, dry summer, pasture is unproductive. Plants that have deep root systems, such as bromegrass, are better suited. Brush removal is needed in places. Pasture production can be increased by application of the proper kind and amount of nutrients. Potassium is needed to maintain legume stands. Control of weeds, clipping mature plants, and management of grazing are needed to maintain a good cover of desirable plants. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

A few areas of this soil are in woodland, mainly American elm, silver maple, and eastern cottonwood. Most areas have been cleared for cropland. This soil has fair suitability for trees. Existing woodlands can be improved by removing undesirable species, eliminating grazing, and restocking with more desirable tree species.

This soil is generally not suitable for building site development because of the flooding hazard. It is generally not suitable for use as septic tank absorption fields because of flooding and soil wetness and because the soil does not adequately filter the effluent. Soils that are better suited to these uses are commonly nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding.

This soil is in capability subclass IIIs.

1888—Moundprairie silty clay loam, occasionally flooded. This poorly drained, nearly level soil is in shallow drainageways and along the lower end of the Root River. This soil is subject to occasional flooding. Areas are broad and irregular in shape and range from 5 to about 40 acres.

Typically, the surface layer is very dark gray, calcareous, mottled silty clay loam about 10 inches thick. The next layer is very dark gray, calcareous silt loam about 30 inches thick that is laminated with varying colors and textures. The underlying material is a buried soil to a depth of about 60 inches. The upper part is black, friable silty clay loam, and the lower part is very dark gray silty clay loam. In a few places the upper part of the surface layer is fine sandy loam or very fine sandy loam. Small areas are loamy throughout, and a few areas are underlain by sand at a depth of less than 40 inches. Some areas do not have calcareous silty layers. Small areas are very poorly drained.

Included with this soil in mapping are small areas of poorly drained Kalmarville soils. The Kalmarville soils contain more sand than this Moundprairie soil. These soils are along the edges of former channels. They make up 1 to 2 percent of mapped areas.

Water and air move through this soil at a moderate rate. Surface runoff is slow. The available water capacity is very high. The availability of phosphorus and potassium in the subsoil is medium. The upper part of the solum is mildly alkaline, and the lower part is neutral or mildly alkaline. The content of organic matter in the surface layer is moderate. The water table is at a depth of 1 foot to 3 feet. The rooting zone extends to the water table. Where the soil is drained, the rooting zone extends to a depth of 40 inches or more. This soil is moderately difficult to till. It can be tilled through a moderately wide range of soil moisture.

Most areas of this soil are used for pasture. Some areas are used for cropland. This soil is well suited to cropland. Corn for grain and silage is the common crop. Production can be increased if the water table is lowered, but in most places drainage is difficult because suitable outlets are difficult to locate. In places sand is within the depth of tile placement and causes trenches to cave and tile to fill with sand. The high content of lime causes nutrient imbalances in some areas.

This soil is well suited to pasture, and pasture production is good throughout the summer. The soil is too wet for most legumes, but reed canarygrass and Garrison creeping foxtail are well adapted. The pasture

in many areas could be improved by controlling weeds and removing brush. Grasses respond well to fertilizer, particularly nitrogen. Deferment of grazing when the soil is wet and allowing plants to reach the proper grazing height help achieve maximum pasture growth. Controlled grazing and proper stocking rates utilize forage efficiently and help maintain the sod in good condition.

This soil is poorly suited to woodland because of wetness. Existing trees are mainly eastern cottonwood, green ash, and American elm. Woodlands can be improved by removing undesirable species. Eliminating grazing encourages natural regeneration.

Areas of this soil are generally not suitable for use as building sites and septic tank absorption fields because of the flooding hazard and seasonal high water table. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding, low soil strength, and frost action.

This soil is in capability subclass IIw.

1889—Moundprairie silty clay loam, depressional. This very poorly drained, level soil is in low lying backwater areas and shallow drainageways along the Root River. This soil is subject to occasional flooding, and some areas are ponded when the water level in the river is high. Areas range from 10 to more than 100 acres.

Typically, the surface layer is very dark grayish brown silty clay loam about 31 inches thick and has dark brown and yellowish red mottles. The underlying material to a depth of about 60 inches consists of a buried soil. It is very dark gray silt loam in the upper part and dark gray silty clay loam in the lower part. In places the surface layer of erosional sediment is less than 20 inches thick. The surface layer is black in some areas. In places sand is within a depth of 40 inches.

Included with this soil in mapping are small areas that have a muck surface layer. They make up less than 1 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface runoff is very slow or ponded. The availability of phosphorus is high and potassium is medium in the subsoil. The upper part of the soil is mildly alkaline, and the lower part is neutral or mildly alkaline. The content of organic matter in the surface layer is moderate. The water table is above a depth of 1 foot most of the year. The rooting zone is restricted by the water table.

Nearly all areas of this soil are used for pasture. Water-tolerant plants, such as reeds and sedges, are dominant. This soil is poorly suited to cropland, pasture, and woodland because of wetness, ponding, and flooding. Many areas contain patches of eastern cottonwood. Water-tolerant pasture, such as reed canarygrass and Garrison creeping foxtail, are suited to this soil where the water table can be lowered enough for seeding. In many places drainage is difficult because suitable outlets are not available. Plants are most productive and most palatable when grazed at the proper height. Proper stocking rates, rotation of pasture, and control of weeds maintain pasture in a productive condition.

This soil is generally not suitable for building sites and septic tank absorption fields because of the flooding and ponding hazard. Soils that are better suited to this use are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding, ponding, and low soil strength.

This soil is in capability class VIIw.

1890—Walford silt loam. This poorly drained, nearly level soil is on the upper end of shallow drainageways and on stream terraces. Slopes are plane. Areas are irregular in shape and range from 3 to about 5 acres.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsoil is about 34 inches thick. The upper part is grayish brown, mottled silt loam; the middle part is grayish brown, mottled silty clay loam; and the lower part is olive gray, mottled silt loam. The underlying material to a depth of about 60 inches is light olive gray, mottled silt loam. Small areas have a black or very dark gray surface layer 10 to 15 inches thick. Some areas are somewhat poorly drained.

Included with this soil in mapping are small areas of poorly drained to somewhat poorly drained silty soils underlain by sand at a depth of 36 to 60 inches. These soils are on positions similar to those of this Walford soil and make up 1 to 5 percent of mapped areas.

Water and air move through this soil at a moderately slow rate. Surface runoff is slow. The available water capacity is very high. In the subsoil the availability of phosphorus is high or very high and potassum is low. The subsoil is medium acid or strongly acid. The content of organic matter in the surface layer is moderate. The seasonal high water table is at a depth of 1 foot to 3 feet. The rooting zone extends to a depth of 60 inches or more if the soil is drained. In undrained areas, root development is limited by the seasonal high water table. Unless drained, this soil warms and dries slowly in spring. It is moderately easy to till. This soil tends to puddle during rains and forms a crust upon drying. The crusting reduces intake of air and water.

Most areas of this soil are used for cropland and are well suited to corn, forage crops, small grain, and soybeans if the soil is drained. Undrained areas are generally poorly suited to cropland because of the wetness. When the soil is too wet, tillage in undrained areas commonly results in compaction and clodding of the surface layer. Drainage with tile lowers the water table and increases rooting depth. Also, the soil warms and dries earlier in the growing season, and the

availability of plant nutrients is increased. A few shallow depressions in areas of this soil require tile systems with surface outlets to prevent ponding. Some areas of this soil do not need drainage because nearby creeks have cut deeply into the terrace, thereby improving the natural drainage. Row crops can be grown successfully every year if drainage is adequate, a proper supply of nutrients is available, and weeds, insects, and diseases are controlled. Friability of the surface layer can be increased by keeping tillage to a minimum, returning crop residue to the soil, and applying manure.

This soil is well suited to forage crops if drained. Suitable varieties and applications of the proper kinds of fertilizer increase yields. Potassium is needed to maintain legume stands. Lime is not generally needed. Harvesting at the proper stage of crop growth increases the quality of forage. This soil is well suited to pasture, and pasture is not generally drained. Bluegrass grows well during the summer because the moisture supply is abundant throughout most of the season. However, deep-rooted legumes or grasses are more productive. Proper fertilization, allowing plants to reach the proper height before grazing, clipping mature plants, and control of weeds increase yields. Grazing in the spring should be deferred until the soil is firm to prevent soil compaction and pasture damage. Proper stocking rates and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Basements of buildings on this soil should be constructed above the seasonal high water table. Tile drains around foundations help to remove excess subsurface water. Landscaping needs to be designed to drain surface water away from buildings. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Backfilling around foundations with suitable coarse material provides added assurance against structural damage. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts minimize the wetness limitation and help protect the roads from damage caused by frost action and low soil strength. This soil is poorly suited to use as septic tank absorption fields because of the seasonal high water table and because the permeability of this soil restricts it from readily absorbing effluent. In some areas a mound-type absorption field is suitable.

This soil is in capability subclass IIIw.

1893C—Beavercreek Variant silt loam, 3 to 8 percent slopes. This well drained, gently sloping to sloping soil is on small fans and narrow flood plains. This soil is subject to occasional flooding. It is crossed by gullies in a few places. Areas are elongated or fan-shaped and range from 3 to about 5 acres.

Typically, the surface layer consists of recently deposited, stratified, very dark brown and dark grayish brown silt loam about 15 inches thick. The underlying material extends to a depth of 60 inches. The upper 15 inches is black loam grading to very dark grayish brown cobbly loam, and the lower part is very dark grayish brown and dark brown cobbly loam. Along flood plains, the surface soil and upper part of the underlying material are dark grayish brown silt loam or fine sandy loam as much as 40 inches thick. In places the depth to cobbly loam is less than 20 inches or more than 40 inches. In some areas the surface layer contains a few dolomite cobbles and flagstones.

Water and air move through this soil at a moderate rate. The available water capacity is moderate. Surface runoff is medium. In the subsoil the availability of phosphorus is high and potassium is low or medium. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The organic matter content of the surface layer is moderate. The water table is below a depth of 6 feet in all seasons. Roots grow easily in the upper 20 to 40 inches of the soil, but growth is slowed in the cobbly layer below. This soil is easy to till. It warms and dries fairly early in the growing season. This soil can be tilled through a wide range of soil moisture.

Most areas of this soil are small and are used for forage crops and pasture. Suitability is fair for these uses. The moderate available water capacity is the main limitation. Production of forage and pasture is low during dry periods, generally in summer. Good management includes using suitable plant varieties and the proper kinds and amount of fertilizer. Lime is not generally needed. Harvesting forage at the proper stage of growth improves forage quality and palatability. Many areas of pasture in bluegrass can be improved by seeding to more productive species. A proper supply of nutrients and allowing plants to reach the proper height before grazing provide more forage. Clipping mature plants and controlling weeds increase the percentage of productive plants. Using proper stocking rates and rotating pasture utilize forage efficiently and maintain the sod in good condition.

A few areas of this soil on stream terraces are used for cropland. Corn is the main crop, but alfalfa-grass forage and small grain are also grown. Suitability is fair for row crops, but late maturing crops, such as corn, suffer from drought in dry years. Because of the slopes, this soil is subject to erosion. Including forage crops in the cropping system, using tillage methods that leave large amounts of crop residue on the surface, and applying manure help control erosion. Some areas of this soil are subject to occasional, very brief flooding during spring snowmelt. This soil is subject to overflow or very brief flooding that deposits sediment on fields, damaging crops. Some areas contain gullies that need stabilization. Drainageways crossing this soil should be shaped, seeded, and maintained as grassed waterways. Some areas need diversions to safely carry overflow from areas upslope.

Trees are well suited to this soil, but only a few areas are in woodland. The main consideration in establishing new plantings is plant competition. This can be controlled by careful spraying with herbicides or by cultivating around seedlings.

This soil is generally not suitable for building sites or septic tank absorption fields because of the flooding hazard. Soils that are better suited to these uses are generally nearby. Constructing roads on raised, coarse textured fill material and providing adequate side ditches and culverts help protect the roads from damage caused by flooding.

This soil is in capability subclass IIIe.

1898F—Etter-Brodale complex, rocky, 25 to 50 percent slopes. This map unit consists of well drained, very steep soils on hillsides below mesalike hills and ridges on uplands. Areas wind around the sides of ridges and mesas in narrow strips and range from 5 to about 40 acres. They are 50 to 85 percent Etter soils and 10 to 50 percent Brodale soils. The Etter soils are on the convex mid and lower parts of the slope along with outcrops of sandstone, and the Brodale soils are on the upper part of the slope. Individual areas of these soils are so intricately intermingled or so small that to separate them in mapping was not practical.

Typically, the surface layer of an Etter soil is very dark grayish brown sandy loam about 8 inches thick. The subsoil is about 14 inches thick. The upper part is brown sandy loam about 9 inches thick, and the lower part is dark yellowish brown loamy sand. The underlying material is pale brown, light yellowish brown, and light brownish gray fine sand. Sandstone is at a depth of less than 20 inches in places. The surface layer or the surface layer and subsoil are loam in places.

Typically, the surface layer of a Brodale soil is black, calcareous loam about 12 inches thick. The underlying material is light olive brown, calcareous, very friable flaggy loam to a depth of about 40 inches. The underlying bedrock is platy, light gray dolomitic limestone. The surface layer is leached of carbonates in places. The limestone contains thin layers of shale in many places.

Included with these soils in mapping are small areas of well drained Boone soils and outcrops of shale. The Boone soils are sandy. They are mostly on south- and southwest-facing nose slopes and make up less than 1 percent of mapped areas. The outcrops of shale make up 1 to 10 percent of mapped areas. Also included are areas in which the soil below a depth of 40 inches is cemented and rocklike.

Air and water move through the Etter soils at a moderate rate in the upper part and at a rapid rate in the underlying material. Air and water move through the Brodale soils at a moderate rate. The available water capacity is low. Surface runoff is very rapid. The Brodale soils are mildly alkaline throughout the solum, and the Etter soils are medium acid. The availability of phosphorus and potassium in the subsoil of both soils is low. The high content of lime in the Brodale soils somewhat limits the availability of other nutrients. The content of organic matter in the surface layer of the Brodale soils is moderate and in the Etter soils is moderately low. The water table is below a depth of 6 feet in all seasons. The rooting zone in both soils is restricted commonly to a depth of less than 30 inches by the sandy or flaggy underlying material.

Most areas of this unit are used for pasture or are left as openland. This map unit is poorly suited to cropland, pasture, and woodland because of the very steep slopes and low available water capacity. The soils produce limited pasture early in spring and early in fall but are not productive throughout the growing season unless rainfall is well distributed. The soils are too steep for improved pasture. Erosion is a severe hazard in pasture. Many areas have been eroded by overgrazing, and pasture is commonly in poor condition. Grazing management and limiting livestock numbers are needed to help maintain pasture in good condition.

Some areas of this map unit support a stand of brush or woodland and are suited to trees. Because of the low available water capacity, most places are better suited to conifers, such as red or jack pine, than to many other species. Many areas have warm south or west exposures. Control of competing vegetation in new plantings may be needed on northerly exposures.

This map unit is generally not suitable for building sites, local roads, or septic tank absorption fields because of the steepness of slope.

This map unit is in capability subclass VIIIe.

1906D—Lindstrom loam, 12 to 20 percent slopes. This well drained, moderately steep to steep soil is on foot slopes below very steep sides of mesalike hills and ridges. Slopes are plane or concave. Areas are long and narrow and tend to wind around the base of ridges. They range from 3 to about 10 acres.

Typically, the surface layer is very dark brown loam about 9 inches thick. The subsurface layer is very dark grayish brown, very friable loam about 16 inches thick. The subsoil to a depth of about 60 inches is dark yellowish brown, very friable silt loam. A few areas that have convex or plane slopes have a very dark brown surface soil 10 to 24 inches thick. A few spots are sandy loam in the surface layer. The lower part of the subsoil in a few places is sandy loam or sand and has 5 to 20 percent fragments of flaggy sandstone.

Included with this soil in mapping are small areas of well drained Plainfield soils. The Plainfield soils have a mantle of loamy sand or sand and are below sandstone outcrops. They make up 2 to 5 percent of mapped areas.

Water and air move through this soil at a moderate rate. The available water capacity is very high. Surface

runoff is rapid. The availability of phosphorus and potassium in the subsoil is medium. The surface layer and subsoil are neutral through medium acid. The content of organic matter in the surface layer is high. The water table is below a depth of 6 feet in all seasons. The rooting zone extends below a depth of 60 inches. This soil warms and dries early in the growing season. It is easy to till and can be tilled satisfactorily through a moderately wide range of soil moisture.

Most areas of this soil are used for cropland. The main crops are corn, alfalfa-grass forage, and small grain. Suitability is fair for row crops, and small grain is well suited. Erosion is a severe hazard because of the steepness of slope. Erosion can be controlled by growing row crops, such as corn, only occasionally and in a rotation with hay crops. Growing corn and forage crops in alternating strips on the contour is well suited to this soil. Tillage methods that maintain a large amount of crop residue on the surface help control erosion. Primary tillage, such as chisel plowing, can be done in spring because the soil warms and dries early. Drainageways develop into gullies easily on this soil unless drainageways are maintained as grassed waterways. Water overflow from steeper soils upslope damages crops in places. This can be overcome with diversions to carry runoff.

This soil is well suited to forage crops and pasture. The water from overflow adds to the moisture supply. Suitable plant varieties, maintaining a proper supply of nutrients, and harvesting at the proper stage of growth increase production and quality of forage. Forage crops and pasture respond well to lime and fertilizer on this soil. Potassium is needed to maintain stands of legumes. Many areas of pasture are bluegrass, and production in these areas can be increased by planting to more productive species. Allowing plants to reach the proper height before grazing, clipping mature plants, and controlling weeds maximize production. Proper rates of stocking and rotating pasture utilize forage efficiently and maintain the sod in good condition.

Trees are well suited to this soil, but areas are not generally used for woodland. On the warm south-facing slopes, the trees that tolerate drier sites are better suited. Most hardwood species grow well on this soil. Where new plantings are started, competing vegetation should be controlled to allow for good growth. Scalping or furrowing the site before planting helps to control competition. Herbicides can be used effectively on many sites. Thinning or pruning of stands helps produce quality timber and optimum growth.

Slope is the main limitation for building sites. Extensive land shaping is generally needed. Buildings and other structures should be designed to conform to the natural slope of the land. Roads constructed on this soil need to be placed on the contour, where possible, and roadbanks should be planted to well adapted grasses to minimize the erosion hazard. Using well compacted, coarse textured base material helps protect roads from frost damage. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IVe.

Prime Farmland

Prime farmland as defined by the U.S. Department of Agriculture is farmland best suited to producing food and fiber for this nation's short- and long-term needs. Prime farmland produces the highest yields with the minimal inputs of energy and economic resources. The U.S. Department of Agriculture recognizes that responsible levels of government and private individuals must be encouraged to use prime farmland with wisdom and foresight. The soils in prime farmland have few limitations that restrict their use for the production of food or fiber. The few limitations can be overcome by good farm management.

Prime farmland may be cropland, pasture, woodland, or other land but is not urban and built-up land or water areas. It usually has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 70,400 acres, or nearly 20 percent of Houston County, meets the requirements for prime farmland. The large areas of prime farmland are mainly in associations 1,2, 7, and 10 on the general soil map. Small areas are scattered throughout the county. The major crops grown on this land are corn and alfalfa hay.

The detailed soil map units that make up prime farmland in Houston County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The detailed soil maps show the location of these farmlands. The soil properties that affect the use and management are described in the section "Detailed Soil Map Units."

Soils that have limitations because of a high water table, droughtiness, or flooding may qualify for prime farmland if the limitation is overcome. In the following list, these limitations are shown in parenthesis after the map unit name. Onsite evaluation is necessary to see if the limitation has been overcome by corrective measures. The map units that meet the soil requirements for prime farmland are:

16 Arenzville silt loam
18 Comfrey silt loam, occasionally flooded (where drained)
25 Becker sandy loam
27B Dickinson sandy loam, 1 to 6 percent slopes
76A Bertrand silt loam, 0 to 2 percent slopes
76B Bertrand silt loam, 2 to 6 percent slopes
103A Seaton silt loam, 1 to 3 percent slopes
103B Seaton silt loam, 3 to 6 percent slopes
131B Massbach silt loam, 3 to 6 percent slopes
136 Madelia silt loam (where drained)
194 Huntsville silt loam, occasionally flooded
216B Lamont fine sandy loam, 1 to 6 percent slopes
250 Kennebec silt loam, occasionally flooded
273 Muscatine silt loam
285A Port Byron silt loam, 1 to 3 percent slopes
285B Port Byron silt loam, 3 to 6 percent slopes
298 Richwood silt loam
301B Lindstrom silt loam, 1 to 6 percent slopes
312B Shullsburg silt loam, 1 to 6 percent slopes
401B Mt. Carroll silt loam, 3 to 6 percent slopes
455A Festina silt loam, 0 to 2 percent slopes
455B Festina silt loam, 2 to 6 percent slopes
463 Minneiska fine sandy loam, occasionally flooded
476B Frankville silt loam, 3 to 6 percent slopes
477 Littleton silt loam
492B Nasset silt loam, 3 to 6 percent slopes
518 Kalmarville silty clay loam, occasionally flooded (where drained)
576 Newalbin silt loam (where drained)
580B Blackhammer-Southridge silt loams, 3 to 6 percent slopes
608 Rawles silt loam, occasionally flooded
1812 Terril loam, sandy substratum
1830 Eitzen silt loam, occasionally flooded
1838 Colo silt loam, overwash (where drained)
1888 Moundprairie silty clay loam, occasionally flooded (where drained)
1890 Walford silt loam (where drained)

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Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops, pasture, and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 43 percent of the county, or about 156,700 acres, is in cropland. Alfalfa-grass forage and corn make up about 80 percent of the cultivated crops grown in the county. Small grain and soybeans are grown on a small acreage. About 31,350 acres, or about 9 percent of the county, is currently used for pasture. The acreage in crops and pasture is gradually decreasing as more land is used for urban development. About 16,000 acres, or 4 percent of the county, is urban land and built-up land. The acreage of land in these uses has been increasing about 0.5 percent per year.

The potential of the soils in Houston County for increased production of food is good, particularly for forage crops and pasture. Most areas suited to cropland and pasture are presently in these uses, but food production can be increased by applying the latest crop production technology to all the land in the county. This soil survey can help facilitate the application of such technology.

The amount of cropland in Houston County is relatively small, but average yields of corn, alfalfa, and small grain are high. Many of the soils used for cropland, such as Mt. Carroll, Port Byron, and Seaton soils, are well drained and moderately well drained and have a very high capacity to hold moisture for plants. Also, they have a deep rooting zone and moderate to high natural fertility. These properties along with a favorable climate help make the land productive.

The control of soil erosion is the major concern of management on about 81 percent of the soils suitable for cropland in Houston County. Most of the soils suitable for cultivation are on the ridges where slopes are long and gently sloping to moderately steep. The soils are easily eroded because they are high in silt, which is easily dislodged by the impact of rainfall and easily transported by surface runoff. If there is a combination of steepness and length of slope and an easily erodible soil, severe erosion can occur.

Loss of soil, particularly the surface soil, is damaging for a number of reasons. First, productivity is lost because nutrients and organic matter are removed, which are costly and must be replaced in order to maintain yields. Secondly, the loss of organic matter and

incorporation of the subsoil layer into the tilled zone or plow layer result in a poorer physical condition or tilth. Erosion is accelerated as tilth or friability decreases. Infiltration of moisture and exchange of air within the soil are also lowered. The soil becomes more difficult to till. Productivity is lowered.

Erosion is especially damaging on soils in which the productive layers are thin, such as in the Edmund and Rollingstone soils. The loss of the thin productive silty mantle results in a cultivated layer of firm clay that is difficult to till. This soil is much less productive than where the silty mantle remains.

Another important reason soil erosion is damaging is that sediment enters streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for fish and wildlife.

Extensive erosion took place in the county from about 1860 to 1940. During this period the ridgetops and valley slopes were cleared. Wheat, and later corn, became important crops. These crops were grown in square fields. Corn was planted up and down slope and was commonly cross-cultivated. Some areas that were cultivated with horse-drawn equipment cannot be farmed with present-day machinery. Some fields were cultivated as many as 8 or 9 times in a season (*10*).

As oxidation of organic matter and excessive tillage reduced the size of clusters of soil particles, raindrops more easily broke down the clusters into finer particles. These filled pores and voids of the surface soil, producing the familiar puddled soil that crusts on drying. Runoff and erosion increased dramatically. Individual particles of soil no longer bound together were carried away. Much of this erosional sediment, mostly silty, was deposited on the floor of stream valleys to an average thickness of 2 to 4 feet (*6*). Cobbles and gravel washed out of gullies on the steep, grazed, wooded valley slopes. Coarse sediment now covers more productive soil along the floor of the upper reaches of valleys.

Erosion is mainly of two types—gully erosion and sheet erosion. Gully erosion is dominant in the county and over a long period of time carved deep valleys before the county was settled. After settlement, cropping the soil with little or no protection from erosion accelerated the erosion process, and gullies became common. In places gullies became so deep and numerous they could no longer be crossed by mechanized equipment, and fields had to be abandoned.

The gullies on cropland today have mostly been filled, shaped, and seeded to grassed waterways. Many small dams have been constructed at the heads of steep gullies to help reduce the erosion in pasture and woodland below.

Sheet erosion is most intense on the convex or rounded parts of the steeper slopes. These convex slopes have lost all or part of the surface layer. However, many cropped fields and some pasture show evidence that much of the original surface layer remains, though severe gullies may be present a few feet away. Generally, the nearly level to gently sloping cultivated soils and soils that have not been cultivated have experienced little soil loss.

Since the last part of the 1930's, the applications of soil conservation practices have significantly reduced soil loss. Most of the farms in the county are livestock farms that are well suited to management to control water erosion. Livestock utilizes large amounts of forage and pasture. Pasture containing grasses that provide a dense sod protects the soil from erosion. Forage crops also promote the development of clusters of soil particles, or aggregates, and provide gluelike substances that help the aggregates to resist the impact of rainfall and the cutting action of runoff. These gluelike substances persist for 2 or 3 years. Legume-grass forage in the cropping system produces nitrogen for the following year's crop.

Contour stripcropping and terraces are well suited to the long, smooth slopes on the ridges and valley foot slopes. Contour alternating strips in corn and forage crops have been applied on most farms in the county. This erosion control practice is used mainly where soils are sloping to moderately steep, such as in areas of Blackhammer and Frankville soils.

Terraces are common on the broad sloping ridgetops in the central and southwestern parts of the county. The silty Mt. Carroll, Port Byron, and Seaton soils are well suited to terraces because of their long slopes and deep friable soils. Cutting and filling during construction will not encounter bedrock or dense clayey subsoil material.

Since gully erosion is significant in Houston County, grassed waterways are a much needed and important practice. Shallow drains crossing sloping soils easily develop into gullies unless the drains are shaped, seeded, and maintained in grass.

Wind erosion is of minor concern in Houston County because there are only a few sandy soils easily blown by wind. Furthermore, areas of these soils, of which Sparta and Plainfield soils are examples, are small and in valleys partially protected from winds. Maintaining plant cover, using surface mulch, or roughening the surface through tillage minimize soil blowing on these soils.

Methods of tillage that leave crop residue on the surface are increasing in use in Houston County. These methods help control erosion and are suited to nearly all of the well drained and moderately well drained soils in the county. These soils, of which Port Byron and Southridge soils are examples, warm and dry out early in the growing season. Crop growth is not generally depressed by cool soils if residue is left on the surface. Leaving residue on the surface reduces the amount of soil exposed to raindrop impact. Also, the reduction in tillage promotes the clustering of soil particles into aggregates more resistant to erosion and crusting, increases intake of air and water, and decreases loss of plant nutrients.

Wetness is a limitation on about 3 percent of the soils in the county that are suitable for cropland. Wetness either prevents cropping or significantly reduces yields in most years. The soils on the terraces are easily drained by tile. Along the stream bottoms, successful drainage is dependent upon intercepting ground-water seepage from upslope. Intercepting the seepage generally requires deep trenching and is not always successful. Suitable outlets are difficult to maintain in some areas.

Irrigation in most years can greatly increase crop yields on the sandy soils that have a limitation of low or moderate available water capacity. Sparta and Lamont soils are examples. These kinds of soil make up about 3 percent of the soils suitable for cultivated crops. They can be of high value if irrigated and used for truck crops. Permits for water usage must be obtained from the Department of Natural Resources.

Flooding is the main limitation on about 7 percent of the soils suitable for cultivation. Most floods are early in spring, and they recede in time for planting. In places the cropland is protected from flooding by roads, dams, and dikes. Most soils that are subject to flooding, flood less frequently than in past years. There are a number of reasons for this. First of all, present-day peak flows are less because the soils are more protected by conservation practices and are in better tilth. Secondly, the filling of flood plains with sediment has caused a deeper channel as the height of channel banks increased and as the thickness of sediment increased. This deepening has significantly increased the capacity of the channel to carry runoff (*6*).

Natural soil fertility is fairly high in the deep silty soils in the county. The subsoil of most of the soils on the ridgetops, valley foot slopes, and silty terraces, of which Seaton soils are an example, is very high in phosphorus and low in potassium. The Rollingstone soils formed mainly in clayey material and are low in phosphorus and medium or high in potassium. Most of the soils on ridges, valley slopes, and terraces are medium acid or strongly acid.

Corn responds well to fertilizer on most soils, particularly to nitrogen and potassium. Periodic application of lime is needed on soils on the ridges, valley slopes, and terraces to raise the phosphorus level sufficiently for good growth. This is especially true for alfalfa and other crops that grow well on slightly acid or neutral soils. Lime is not generally needed for legumes on bottom land soils because they are typically neutral or mildly akaline. Legumes respond well to potassium because it increases yields and plant resistance to winterkill.

Organic matter is an important source of nitrogen for plants. Dairy cattle provide large amounts of organic matter in the form of manure. The manure is mostly applied to cropland. In addition to improving fertility, it increases the water intake, reduces surface crusting, and decreases soil losses from erosion.

About 9 percent of the soils in Houston County are used for pasture. Pasture is typically in areas of soils that are poorly suited to cultivated crops because of steep slopes, low moisture capacity, or wetness. Some areas of soil suitable for cropland are used for pasture because areas are too small or irregular in shape to farm efficiently.

Kentucky bluegrass in varying condition is the main pasture species in most places. Many areas of pasture are brushy or weedy. In areas in which the slope limitation is not too great, removal of brush and weeds and replacing the bluegrass with more productive plants greatly increase yields.

Birdsfoot trefoil grows well on poorly drained to well drained soils but can be difficult to establish. Bromegrass, orchardgrass, and alfalfa are well suited to the well drained and moderately well drained soils in the county. Once established, pasture can be maintained and kept productive by fertilizing and liming according to soil test and allowing plants to reach the proper height before grazing. Clipping of mature plants and controlling weeds increase yields of forage by increasing the number of productive plants. Controlling livestock numbers, managing grazing, and rotation of pasture maximize utilization of forage.

Bottom land pasture utilizes soils that are too wet or are divided into small tracts by the dissection of meandering streams. Most areas are in bluegrass. Soils on the meandered bottoms are difficult to reseed. Management potential is generally limited to removing brush and trees, controlling livestock numbers, and rotation grazing. Only a few areas, however, are used for rotation pasture. The wet soils, such as Newalbin silt loam, channeled, are well suited to bluegrass. They typically remain productive throughout the summer. In places that are inaccessible to mechanized equipment, planting to reed canarygrass or Garrison creeping foxtail provides more forage (*15*).

Small areas in Houston County are used for apple orchards. Most of the orchards are concentrated near the town of La Crescent. The Seaton and Council soils on valley slopes below north- and east-facing bluffs are better suited to orchards than some other soils. These soils are slower to warm in spring, which holds back the bloom and thus avoids damage from late killing frosts. The valleys are preferred over the ridges for the location of orchards. In many places orchards on soils on the ridges are successful, but wind can interfere with spraying or can cause severe dropping of fruit. South- and west-facing slopes warm up too rapidly in spring, and this causes early blossoms, which are susceptible to frost. Occasional warm spells cause winter injury to trees.

If orchard sites that have good air circulation are selected, cold air moving down the slopes moves out of the orchard and does not cause frost pockets. Orchards are typically planted on soils that are too steep for row

crops. If the slope is more than 20 percent, operation of spraying equipment is hazardous, but in some areas mechanical equipment is successfully used to manage trees on slopes as much as 30 percent.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Yields of alfalfa and bromegrass pasture assume a high level of management. This includes liming and fertilizing; allowing plants to reach the proper height suitable for maximum growth and recovery; rotating three or more pasture areas and resting pasture plants between grazing periods; clipping to stimulate new plant growth; and controlling weeds to increase the percentage of productive plants. Yields of bluegrass pasture assume a level of management where livestock numbers are adjusted to the carrying capacity of the pasture for the grazing season. Production can be increased significantly if a high level of management, as defined for alfalfa-bromegrass pasture, is used.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Woodland Management and Productivity

John Hultgren, forester, Soil Conservation Service, and David Svien, forester, State Department of Natural Resources, helped prepare this section.

Virgin forest covered most of the land in Houston County at the time of settlement. The southwestern part of the county was covered with tall grass prairie, brush, and scattered groves of bur oak. The trees have been cleared on nearly all the soils used for cultivated crops. The soils in many of the remaining areas of woodland are too steep, too wet, or too small in extent to use for cropland. The soils in these areas produce trees of good quality if the woodland is properly managed.

Woodland now makes up about 40 percent of the county. The largest areas of woodland are in associations 4 and 12 shown on the general soil map. The most common trees on the steep to very steep sides of the ridges in association 4 are oak, shagbark hickory, butternut hickory, quaking aspen, and paper birch. The trees are mostly on slopes bordering the narrow upper reaches of valleys and on northerly slopes along the wider valleys. Southerly exposures, particularly along the wider valleys, consist of bunchgrasses and other prairie species.

Small areas of woodland are on the narrow ends of the ridgetops in association 3. The most common trees at the time of settlement were whiteoak, red oak, elm, basswood, maple, wild cherry, and a small amount of pine. This vegetation covered most of the county.

The main species on the bottom lands are cottonwood, black ash, yellow birch, hackberry, silver maple, red maple, and willow. Although the largest areas of woodland on bottom lands are in association 12, small tracts also exist in associations 4, 7, 8, 9, 10, and 11. Much of the woodland on the flood plain in association 10 is inaccessible except by water. Nearly all of this woodland is part of the natural wildlife refuge system.

Many areas of the existing woodland would benefit if mature trees were thinned, undesirable species removed, and livestock grazing eliminated. Protection from fire and control of insects and disease are also needed. Logging roads, skid trails, and livestock paths are prime sources of eroded sediment from woodland on steep slopes.

The Soil Conservation Service, Cooperative Extension Service, or private foresters can help determine specific woodland management needs.

Table 6 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 6, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant

competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

Woodland Understory Vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some woodland, if well managed, can produce enough understory vegetation to support wildlife without damage to the trees.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Recreation

Houston County, with its deeply carved landscape of valleys, steep hillsides, and ridgetops, has many areas of scenic, geological, and historical interest. These areas are used for camping, hiking, hunting, fishing, sightseeing, picnicking, and boating. Public lands available for recreation include areas within the Upper Mississippi Wildlife Refuge, scattered tracts owned by the Minnesota State Department of Natural Resources, and Beavercreek State Park.

Use of the soils of Houston County for recreation has been on the increase in recent years. Many soils are suited to recreational facilities. Soils that are better suited to recreation are in associations 3, 4, 9, and 12 shown on the general soil map. Associations 3, 4, and 9 have narrow ridgetops, steep wooded hillsides, and many streams, some of which support trout.

Association 12 is characterized by numerous marshes, backwater stream channels, and low narrow wooded strips above the lower lands. This association provides hunting for deer, waterfowl, and small game. Fur trapping is an important activity in the marshes.

A system of snowmobile trails has been constructed in associations 3, 4, 6, 7, 8, 9, and 10. The wooded hillsides and narrow ridges and valleys provide large areas of land for turkey and deer hunting in the county. The marshes along the Mississippi River comprise an important refuge and hunting area. The Mississippi River is popular for fishing and boating. The sandbars along the channel provide attractive picnicking and camping sites for boaters. The Root River is suitable for canoeing. Many areas in these associations have good potential for further development for campgrounds, picnic areas, hiking, horseback riding, and snowmobile trails.

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table

10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Houston County has a large and varied population of fish and wildlife. White-tailed deer, cottontail, squirrels, raccoons, ruffed grouse, woodchucks, hawks, and many types of songbirds inhabit the wooded areas. In recent years wild turkeys have been introduced, and their population is increasing. Pheasants and cottontails live in the farmed areas where food and cover is available. Some creeks and streams support brook, rainbow, and brown trout. Brook trout are confined to the narrower, colder streams. The ponds and marshes along the Mississippi River provide resting and feeding areas for migratory waterfowl in fall and spring. The river supports a wide variety of game fish, including northern pike, walleye, sauger, bass, sunfish, and crappies. Rough fish of many species are harvested by commercial fishermen. Many areas in the county can be improved for use as wildlife habitat by increasing the food, cover, and water supply that wildlife need.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also

considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5)

plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 10 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that

part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability

of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil

material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 to 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

In table 15, some soils are assigned to two hydrologic groups. The first letter is for drained areas, and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than

that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*16*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 16 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludolls (*Hapl*, meaning minimal horizonation, plus *udoll*, the suborder of the Mollisols that have a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Hapludolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*14*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*16*). Unless otherwise stated, matrix colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Abscota Series

The Abscota series consists of deep, well drained and moderately well drained, rapidly permeable soils on flood plains along rivers and streams. These soils formed in sandy alluvium. They are occasionally flooded, generally in spring. Slope ranges from 1 to 6 percent.

Abscota soils are associated on the landscape with Minneiska and Rawles soils along the Root River. Typically, these soils are further from the channel than Abscota soils. Minneiska soils are loamy, and Rawles soils are silty.

Typical pedon of Abscota loamy sand, occasionally flooded; 1,780 feet north and 100 feet west of the southeast corner of sec. 26, T. 104 N., R. 7 W.

A—0 to 8 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; strong effervescence; mildly alkaline; gradual smooth boundary.
C—8 to 60 inches; light brownish gray (10YR 6/2) sand; very dark grayish brown (10YR 3/2) and grayish brown (10YR 4/2) masses; single grain; loose; strong effervescence; mildly alkaline.

The control section typically is mildly alkaline, but in some pedons it is neutral to a depth of 30 inches. Horizonation is commonly not distinct.

The A horizon has value of 3 or 4 and chroma of 1 through 3. It is sand, loamy sand, or sandy loam. Some pedons have an Ap horizon 5 to 10 inches thick. The C horizon has value of 4 through 6 and chroma of 2 through 4.

Abscota Variant

The Abscota Variant consists of deep, well drained and moderately well drained, rapidly permeable soils. These soils are on fans at the mouth of drainageways and gullies below stream terraces along the Root River. They formed in stratified sandy and loamy alluvium. These soils are subject to occasional flooding. Slope ranges from 2 to 6 percent.

Abscota Variant soils are similar to Minneiska Variant soils. Minneiska Variant soils are next to major stream channels. They are underlain by loamy material at a depth of less than 40 inches.

Typical pedon of Abscota Variant sand, 2 to 6 percent slopes; 2,255 feet east and 1,000 feet north of the southwest corner of sec. 21, T. 104 N., R. 7 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) sand, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; many very fine roots; neutral; abrupt smooth boundary.
C—3 to 60 inches; stratified grayish brown (10YR 5/2), brown (10YR 4/3), and pale brown (10YR 6/3) sand and loamy sand and very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) fine sandy loam, very fine sandy loam, loam, and silt loam; single grain or weak very fine subangular blocky structure; loose in sand, friable in subhorizons containing more clay; about 2 percent gravel in the lower part of horizon; neutral.

Typically, the soil is neutral to a depth of 30 inches or more, but in a few pedons free carbonates are at a depth of less than 30 inches. Individual subhorizons range widely in color and texture. Hue is typically 10YR, but in some pedons hue is 2.5Y below a depth of 20 inches. Value ranges from 3 to 6 and chroma from 2 to 4. Some pedons have layers 1/2 inch to 5 inches thick that have as much as 15 percent gravel.

Arenzville Series

The Arenzville series consists of deep, moderately well drained, moderately permeable soils on narrow flood plains (fig. 14). These soils formed in silty alluvium and the underlying loamy alluvium. They are occasionally flooded during spring. Slope ranges from 0 to 3 percent.

Arenzville soils are associated on the landscape with Huntsville and Newalbin soils. Huntsville soils have a thick mollic epipedon and commonly are at a slightly higher elevation than Arenzville soils. Newalbin soils are poorly drained and very poorly drained and are at a lower elevation.

Typical pedon of Arenzville silt loam; 700 feet west and 2,450 feet south of the northeast corner of sec. 22, T. 102 N., R. 5 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine and very fine granular structure; very friable; mildly alkaline; clear smooth boundary.
C—10 to 32 inches; stratified, brown (10YR 4/3) and very dark grayish brown (10YR 3/2) silt loam and few thin strata of brown (10YR 5/3) and very dark brown (10YR 3/2) very fine sandy loam and loamy very fine sand; moderate fine and very fine platy structure; very friable; mildly alkaline; abrupt smooth boundary.
Ab1—32 to 46 inches; black (10YR 2/1) loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very friable; neutral; clear smooth boundary.
Ab2—46 to 56 inches; very dark gray (10YR 3/1) loam; moderate fine subangular blocky structure; very friable; neutral; clear smooth boundary.
C'—56 to 60 inches; dark brown (10YR 4/3) loam and many thin strata of dark grayish brown (10YR 4/2) and brown (10YR 5/3) sandy loam, fine sandy loam, and very fine sandy loam; common medium prominent dark reddish brown (5YR 3/4) and yellowish red (5YR 4/6) mottles; massive; very friable; mildly alkaline.

Depth to the buried A horizon ranges from 20 to 40 inches. The solum is neutral or mildly alkaline.

The A horizon typically has value of 4 and chroma of 2 but in some pedons has thin strata that have value of 3 through 5 and chroma of 2 or 3. Dominant strata in the C horizon have chroma of 2 or 3, and thin strata in this horizon have value of 3 through 5 and chroma of 2 or 3. The thin strata are loamy very fine sand, very fine sandy loam, loamy fine sand, very fine sand, or fine sand. The Ab horizon is commonly 10 to 30 inches thick. It is loam

Figure 14.—Profile of Arenzville silt loam. Stratified recent silty sediment has been eroded from nearby ridges. It is about 30 inches thick over the dark sediment that was the original surface layer. The scale is in feet.

or silt loam that has value of 2 or 3. The C' horizon has hue of 10YR, value of 4 or 5, and chroma of 2 through 4. This horizon has distinct or prominent mottles. It is loam, fine sandy loam, or sandy loam.

Beavercreek Series

The Beavercreek series consists of deep, well drained and moderately well drained soils on flood plains and alluvial fans. These soils formed in a thin mantle of loamy alluvium and the underlying loamy-skeletal alluvium. They are subject to occasional flooding. Permeability is moderately rapid. Slope ranges from 1 to 12 percent.

Beavercreek soils are associated on the landscape with Arenzville and Huntsville soils. These soils are silty and are commonly downstream from Beavercreek soils.

Typical pedon of Beavercreek fine sandy loam, in an area of Beavercreek-Arenzville complex, 1 to 12 percent slopes; 1,200 feet south and 1,200 feet west of the northeast corner of sec. 22, T. 102 N., R. 5 W.

A—0 to 5 inches; dark brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

C1—5 to 12 inches; stratified brown (10YR 5/3) and pale brown (10YR 6/3) fine sand and dark grayish brown (10YR 4/2) silt loam; weak thin platy structure; very friable; about 5 percent pebbly and cobbly dolomite fragments; neutral; gradual wavy boundary.

2C2—12 to 60 inches; stratified dark grayish brown (10YR 4/2), brown (10YR 5/3), and pale brown (10YR 6/3) cobbly silt loam, cobbly fine sand, cobbly loamy fine sand, and sand; weak very fine subangular blocky structure; very friable; about 15 percent pebbles and 40 percent dolomite cobbles; neutral.

Free carbonates are typically absent to a depth of 40 inches or more but are as shallow as 20 inches in some pedons. Cobbles and pebbles cover from 0 to 50 percent of the surface. Dolomitic pebbles and cobbles make up as much as 35 percent of the C horizon and 35 to 70 percent of the 2C horizon. The coarse fragments consist of sandstone, dolomite, and limestone. The upper loamy alluvium is 5 to 20 inches thick.

The A and C horizons in the upper loamy alluvium have value of 3 through 6 and chroma of 2 or 3. Value is 4 or more when these horizons are mixed. They are stratified fine sand, loamy fine sand, fine sandy loam, very fine sandy loam, loam, or silt loam. The 2C horizon has hue of 10YR to 2.5Y, value of 4 through 6, and chroma of 2 through 4. The fine earth fraction is dominantly fine sandy loam, but thin strata of sand, fine sand, loamy fine sand, loamy sand, very fine sandy loam, loam, and silt loam are included. The 2C horizon is

neutral or mildly alkaline. In some pedons a buried A horizon is at a depth of more than 40 inches.

Beavercreek Variant

The Beavercreek Variant consists of deep, well drained, moderately permeable soils on alluvial fans, terraces, and flood plains. These soils are at the mouth of drainageways that dissect very steep valley slopes. They formed in silty to loamy alluvium. They are subject to occasional flooding. Slope ranges from 3 to 8 percent.

Beavercreek Variant soils are similar to and are associated on the landscape with Beavercreek soils. Beavercreek soils are on positions similar to those of Beavercreek Variant soils but are more shallow to skeletal material.

Typical pedon of Beavercreek Variant silt loam, 3 to 8 percent slopes; 1,600 feet south and 150 feet east of the northwest corner of sec. 10, T. 103 N., R. 5 W.

A—0 to 15 inches; stratified very dark brown (10YR 2/2) and dark grayish brown (10YR 4/2) silt loam, dark grayish brown (10YR 4/2) and brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; about 2 percent pebbles of dolomite; neutral; clear smooth boundary.

Ab1—15 to 23 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; very friable; about 5 percent pebbles of dolomite; neutral; clear smooth boundary.

Ab2—23 to 30 inches; very dark grayish brown (10YR 3/2) cobbly loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; very friable; about 20 percent cobbles and pebbles of dolomite; neutral; clear smooth boundary.

2Ab1—30 to 40 inches; very dark grayish brown (10YR 3/2) cobbly loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; very friable; about 45 percent pebbles and cobbles of dolomite; neutral; clear smooth boundary.

2Ab2—40 to 60 inches; dark brown (10YR 3/3) cobbly loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; very friable; about 45 percent pebbles and cobbles of dolomite; neutral.

The solum is 40 to 72 inches thick. The stratified part of the A horizon is 0 to 15 inches thick. It has value of 2 through 4 and chroma of 2 or 3. It is fine sandy loam, loam, or silt loam. The Ab horizon has value of 2 or 3 and chroma of 1 through 3. Fine earth in the upper part is loam or fine sandy loam. Fine earth in the 2Ab horizon is loam or sandy loam. This horizon contains more than 35 percent pebbles and cobbles. It is neutral or slightly acid. A B horizon is present in some pedons.

Becker Series

The Becker series consists of deep, well drained soils on flood plains along the Root River and in narrow valleys. These soils formed in loamy alluvium and the underlying sandy alluvium. They are subject to rare flooding. Permeability is moderately rapid. Slope ranges from 0 to 2 percent.

Becker soils are associated on the landscape with Arenzville and Huntsville soils. Arenzville soils are silty and typically are at a lower elevation than Becker soils. Huntsville soils are silty and are on positions similar to those of Becker soils.

Typical pedon of Becker sandy loam; 2,650 feet west and 1,535 feet south of the northeast corner of sec. 31, T. 104 N., R. 6 W.

Ap—0 to 12 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; medium acid; abrupt smooth boundary.

A1—12 to 22 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak and moderate very fine subangular blocky; very friable; medium acid; clear smooth boundary.

A2—22 to 28 inches; dark brown (10YR 3/3) sandy loam; dark brown (10YR 4/3) dry; weak coarse subangular blocky structure parting to moderate fine subangular blocky; very friable; medium acid; clear smooth boundary.

2Bw—28 to 34 inches; brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

2C1—34 to 42 inches; brown (10YR 4/3) sand; single grain; loose; slightly acid; clear smooth boundary.

2C2—42 to 60 inches; dark yellowish brown (10YR 4/4) fine sand; single grain; loose; neutral.

The solum is 24 to 48 inches thick. The loamy mantle is 25 to 40 inches thick. The mollic epipedon is 24 to 36 inches thick.

The A horizon has chroma of 1 or 2. It is fine sandy loam, sandy loam, or loam. It is slightly acid or medium acid. The 2B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It is loamy sand or sand. The 2C horizon typically is fine sand or sand but in some pedons contains strata that have as much as 20 percent coarse sand and as much as 5 percent fine gravel.

Bertrand Series

The Bertrand series consists of deep, well drained, moderately permeable soils on stream terraces along the Root River and its tributaries. These soils formed in a mantle of silty and loamy alluvium derived from loess

and in the underlying sandy alluvium. Slope ranges from 0 to 6 percent.

The Bertrand soils in Houston County are outside the range defined for the Bertrand series because the surface layer has a slightly darker color. This difference, however, does not alter the usefulness or behavior of the soils.

Bertrand soils are similar to Festina and Richwood soils. Festina soils are more than 60 inches deep to sand, and Richwood soils have a mollic epipedon. These soils are on positions similar to those of Bertrand soils.

Typical pedon of Bertrand silt loam, 0 to 2 percent slopes; 500 feet east and 200 feet north of the southwest corner of sec. 24, T. 104 N., R. 7 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 5/1) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

BA—9 to 14 inches; dark brown (10YR 4/3) silt loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate very fine subangular blocky structure; friable; light gray (10YR 7/1) silt coatings on faces of peds; slightly acid; clear smooth boundary.

Bt1—14 to 21 inches; dark yellowish brown (10YR 4/4) silt loam; dark brown (10YR 3/3) coatings on faces of peds; moderate medium subangular blocky structure; friable; thin light gray (10YR 7/1) silt coatings on faces of peds; few moderately thick very dark brown (10YR 3/2) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—21 to 35 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown coatings on faces of peds; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; friable; common moderately thick dark brown (10YR 3/3) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3—35 to 43 inches; yellowish brown (10YR 5/4) silt loam; weak coarse subangular blocky structure; friable; few moderately thick dark brown (10YR 3/3) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt4—43 to 49 inches; yellowish brown (10YR 5/4) loam; common fine distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/8) mottles; moderate coarse subangular blocky structure; friable; few moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; few manganese concretions; strongly acid; clear smooth boundary.

2BC—49 to 53 inches; yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) sand; single grain; loose; strongly acid; abrupt smooth boundary.

2Bt—53 to 55 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; common moderately thick clay films as bridgings between sand grains; very friable; strongly acid; abrupt smooth boundary.

2C—55 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; strongly acid.

The thickness of the solum ranges from 45 to 65 inches. Depth to free carbonates is more than 72 inches. The silty mantle is 40 to 54 inches thick.

The Ap horizon has value of 3 or 4 and chroma of 1 or 2. It is slightly acid or medium acid. An E horizon is present in some pedons. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is slightly acid or medium acid in the upper part and medium acid or strongly acid in the lower part. The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam, loam, sandy loam, sand, or loamy sand and is medium acid or strongly acid. The 2C horizon has value of 4 through 6 and chroma of 3 through 6. It is fine sand or sand and is slightly acid through strongly acid. In some pedons this horizon has thin strata of loamy material.

Billett Series

The Billett series consists of deep, well drained soils on terraces along the Root River and the lower reaches of its tributaries. These soils formed in loamy alluvium and the underlying sandy alluvium. Permeability is moderately rapid. Slope ranges from 1 to 12 percent.

Billett soils are associated on the landscape with Dickinson, Gotham, and Lamont soils. These soils are on positions similar to those of the Billett soils. Dickinson soils have a mollic epipedon, and Gotham soils are sandy. Lamont soils have more than 36 inches of loamy material over sandy material and have a lighter colored surface layer.

Typical pedon of Billett sandy loam, 1 to 6 percent slopes; 2,375 feet west and 1,725 feet north of the southeast corner of sec. 21, T. 104 N., R. 7 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; slightly acid; abrupt smooth boundary.

BA—9 to 14 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

Bt1—14 to 26 inches; dark yellowish brown (10YR 4/4) sandy loam; medium subangular blocky structure; few thin very dark grayish brown (10YR 3/2) clay films on faces of peds; very friable; medium acid; clear smooth boundary.

Bt2—26 to 30 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse subangular blocky structure; very friable; few thin very dark grayish brown (10YR 3/2)

clay films on faces of peds; medium acid; clear smooth boundary.
2BC—30 to 36 inches; brownish yellow (10YR 6/6) sand; single grain; loose; slightly acid; abrupt smooth boundary.
2C—36 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; slightly acid.

The solum is 30 to 45 inches thick. The loamy mantle is 26 to 36 inches thick.

The A horizon has chroma of 2 or 3. In areas that have not been cultivated, an E horizon 2 to 5 inches thick is present. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma 4 through 6. The 2BC horizon has value and chroma of 4 through 6. It is sand or loamy sand and is medium acid or strongly acid. The 2C horizon has hue of 7.5YR through 2.5Y, value of 3 through 6, and chroma of 3 through 5.

Blackhammer Series

The Blackhammer series consists of well drained, moderately permeable soils on ridgetops of dissected uplands. These soils formed in a mantle of loess and in the underlying stratified loamy and sandy erosion sediment overlying sandstone or limestone. Slope ranges from 3 to 20 percent.

Blackhammer soils are associated on the landscape with Mt. Carroll, Nodine, Rollingstone, Seaton, and Southridge soils. Mt. Carroll and Seaton soils typically are upslope from Blackhammer soils where the loess mantle is thicker. Nodine, Rollingstone, and Southridge soils are on positions similar to those of Blackhammer soils. Nodine and Rollingstone soils have a thinner loess mantle. Southridge soils have a clayey 2B horizon.

Typical pedon of Blackhammer silt loam, in an area of Blackhammer-Southridge silt loams, 12 to 20 percent slopes, eroded; 1,700 feet south and 1,600 feet east of the northwest corner of sec. 11, T. 103 N., R. 4 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; many fine and very fine roots; slightly acid; clear smooth boundary.
BA—7 to 10 inches; dark yellowish brown (10YR 4/4) silt loam; dark brown (10YR 4/3) coatings on peds; weak fine subangular blocky structure; very friable; common fine roots; medium acid; clear smooth boundary.
Bt1—10 to 27 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown (10YR 4/4) coatings on peds; moderate medium subangular blocky structure; friable; few fine and very fine roots; few thin clay films on faces of peds; medium acid; clear smooth boundary.
2Bt2—27 to 60 inches; stratified strong brown (7.5YR 5/6), reddish yellow (7.5YR 6/6), yellowish red (5YR 5/6), and reddish brown (5YR 4/4) clay loam, sandy clay loam, sandy loam, loamy sand, and sand; massive in coarser textured part to moderate coarse subangular blocky structure in finer textured part; few moderately thick clay films on faces of peds in finer textured part; strongly acid.

Thickness of the solum and the depth to free carbonates and bedrock typically range from 60 to 100 inches but are more than 100 inches in some pedons. The depth of the silty mantle ranges from 15 to 30 inches.

The Ap horizon has value of 3 or 4 when wet and 6 or more when dry and has chroma of 2 or 3. In soils that have not been cultivated, an A horizon ranging from 2 to 4 inches in thickness and an E horizon ranging from 3 to 7 inches are present. The A horizon is medium acid through neutral. The B horizon in the silty mantle has value of 4 or 5 and chroma of 3 or 4. It is silt loam or silty clay loam and is slightly acid through strongly acid. The 2Bt horizon is stratified in color and texture. It has hue ranging from 2.5YR through 10YR, but hue of 7.5YR is dominant, and has value and chroma ranging from 4 through 6. Strata in the 2Bt horizon are dominantly sandy clay loam, clay loam, and sandy loam but range to loamy sand, sand, and clay. This horizon is strongly acid or medium acid.

Boone Series

The Boone series consists of moderately deep, excessively drained, rapidly permeable soils on side slopes of ridges and mesas on uplands. These soils formed in sandy residuum weathered from St. Peter, Jordan, or Dresbach sandstone. Slope ranges from 20 to 70 percent.

Boone soils are associated on the landscape with Brodale, Eleva, Etter, and Lacrescent soils. These soils are in positions similar to those of Boone soils. Brodale and Lacrescent soils formed in cobbly or flaggy loamy colluvium derived from dolomite or limestone. Eleva and Etter soils are loamy.

Typical pedon of Boone sand, rocky, 20 to 70 percent slopes; 500 feet north and 1,725 feet west of the southeast corner of sec. 28, T. 104 N., R. 6 W.

A—0 to 3 inches; dark grayish brown (10YR 4/2) sand, light brownish gray (10YR 6/2) dry; very fine granular structure; very friable; many fine roots; slightly acid; clear smooth boundary.
C1—3 to 15 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; slightly acid; clear smooth boundary.
C2—15 to 34 inches; yellowish brown (10YR 5/6) sand; single grain; loose; slightly acid; clear smooth boundary.
Cr—34 to 60 inches; very pale brown (10YR 7/3) weakly cemented sandstone; slightly acid.

Thickness of the solum and the depth to sandstone range from 20 to 40 inches. The sandstone is soft to slightly hard. Coarse fragments, smaller than 3 inches in diameter, make up as much as 15 percent, by volume, of the soil.

The A horizon is sand, fine sand, sand, or loamy fine sand 2 to 5 inches thick. It has value of 3 or 4 and chroma of 2 or 3. The C horizon is sand or fine sand. The upper part has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 through 5. The lower part of the C horizon has value of 5 through 7 and chroma of 3 through 6.

Boots Series

The Boots series consists of deep, very poorly drained organic soils on flood plains. These soils formed in partially decomposed reeds and sedges. They are subject to occasional flooding. Permeability is moderately rapid. Slope is 0 to 1 percent.

Boots soils are similar to the Palms soils and are associated on the landscape with Moundprairie soils. Palms soils formed in more decomposed organic soil material than Boots soils and are along narrow stream channels elevated slightly above the flood plain. Moundprairie soils are silty and are at a slightly higher elevation.

Typical pedon of Boots mucky peat; 1,950 feet east and 75 feet north of the southwest corner of sec. 35, T. 104 N., R. 5 W.

Oel—0 to 22 inches; very dark brown (10YR 2/2) partially decomposed hemic material, black (10YR 2/1) rubbed; 60 percent fiber unrubbed and 30 percent rubbed; primarily herbaceous fibers; 20 percent mineral material; neutral; gradual smooth boundary.

Oe2—22 to 60 inches; dark brown (7.5YR 3/2) partly decomposed hemic material, very dark brown (7.5YR 2/2) rubbed; massive; 75 percent fiber unrubbed and 40 percent rubbed; primarily herbaceous fibers; 20 percent mineral matter; neutral.

Layers within the subsurface and bottom tiers have hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 through 3. They are predominantly hemic material, but sapric layers as much as 10 inches thick are in some pedons.

Brodale Series

The Brodale series consists of deep, excessively drained, moderately permeable soils on very steep hillsides on uplands. These soils formed in loamy-skeletal colluvium. Slope ranges from 45 to 70 percent. Most slopes are south or west facing.

Brodale soils are associated on the landscape with Boone, Etter, Lacrescent, and Sogn soils. Boone and Etter soils are downslope from Brodale soils and underlain by sandstone within a depth of 40 inches. Lacrescent soils are on positions similar to those of Brodale soils but are deeper to carbonates. Sogn soils are on summits and are underlain by limestone bedrock at a shallow depth.

Typical pedon of Brodale cobbly fine sandy loam, rocky, 45 to 70 percent slopes; 300 feet south and 1,300 feet east of the northwest corner of sec. 30, T. 102 N., R. 4 W.

A1—0 to 7 inches; very dark gray (10YR 3/1) cobbly fine sandy loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; about 25 percent coarse fragments; neutral; clear smooth boundary.

A2—7 to 12 inches; very dark grayish brown (10YR 3/2) very cobbly loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; very friable; about 50 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C1—12 to 20 inches; dark brown (10YR 4/3) very cobbly loam; dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine and medium subangular blocky structure; very friable; about 50 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

C2—20 to 31 inches; olive brown (2.5Y 4/3) very cobbly loam; weak fine subangular blocky structure; very friable; about 50 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

C3—31 to 60 inches; light olive brown (2.5Y 5/3) very cobbly loam; weak very fine and fine subangular blocky structure; very friable; about 50 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 7 to 15 inches. Depth to limestone or sandstone bedrock ranges from 40 to 80 inches. The control section has 35 to 70 percent coarse fragments. The coarse limestone fragments typically are cobblestones and pebbles but in some pedons are mostly flagstones and channers. The mollic epipedon is 7 to 20 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The fine earth fraction in the A horizon typically is loam, very fine sandy loam, fine sandy loam, or sandy loam, but in some pedons it is silt loam. It is neutral or mildly alkaline. A B horizon is in some pedons. The C horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 3 through 6. The fine earth fraction of the C horizon is loam, very fine sandy loam, fine sandy loam,

or sandy loam. The underlying bedrock is limestone or sandstone.

Chaseburg Series

The Chaseburg series consists of deep, well drained and moderately well drained, moderately permeable soils along the upper reaches of narrow flood plains. These soils formed in silty alluvium. They are frequently flooded. Slope ranges from 2 to 6 percent.

Chaseburg soils are similar to Arenzville and Eitzen soils. Arenzville soils are on the broader flood plains and have a buried soil within a depth of 40 inches. Eitzen soils are on positions similar to those of Chaseburg soils and are darker colored in the surface layer.

Typical pedon of Chaseburg silt loam, 2 to 6 percent slopes, channeled; 1,550 feet south and 1,400 feet west of the northeast corner of sec. 35, T. 103 N., R. 6 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few thin brown (10YR 5/3) strata throughout; weak very fine subangular blocky structure; very friable; slightly acid; abrupt smooth boundary.

C1—7 to 15 inches; dark grayish brown (10YR 4/2) silt loam; common thin brown (10YR 5/3) strata throughout; weak thin platy structure; very friable; slightly acid; clear smooth boundary.

C2—15 to 56 inches; dark grayish brown (10YR 4/2) silt loam; common thin grayish brown (10YR 5/2) strata throughout; weak thin platy structure; very friable; medium acid; abrupt smooth boundary.

Ab—56 to 60 inches; very dark grayish brown (10YR 3/2) silt loam; very dark brown (10YR 2/2) coatings on faces of peds; moderate fine and medium subangular blocky structure parting to weak very fine subangular blocky; very friable; medium acid.

Depth to free carbonates is 60 inches or more. The buried A horizon is commonly at a depth of 40 to 80 inches. Where the soil has not been cultivated, the A horizon is thin or is not present. The C horizon has value of 3 through 5 and chroma of 2 through 4. Silt loam strata are dominant in the C horizon, but thin strata of very fine sandy loam and loamy very fine sand are common. This horizon is neutral through medium acid. The Ab horizon has value of 2 or 3. It commonly is silt loam, but in some pedons it is loam. It is slightly acid or medium acid.

Colo Series

The Colo series consists of deep, poorly drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. They are occasionally flooded. Slope ranges from 0 to 3 percent.

Colo soils are similar to and are associated on the landscape with Comfrey and Moundprairie soils. These soils are on positions similar to those of Colo soils. Comfrey soils are fine-loamy, and Moundprairie soils are calcareous.

Typical pedon of Colo silt loam, overwash; 950 feet north and 600 feet east of the southwest corner of sec. 26, T. 104 N., R. 6 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 13 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine faint very dark grayish brown (10YR 3/2) mottles; weak thin and medium platy structure; friable; slight effervescence; mildly alkaline; clear wavy boundary.

Ab1—13 to 20 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine granular structure; firm; mildly alkaline; clear wavy boundary.

Ab2—20 to 30 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/2) dry; moderate fine subangular blocky structure parting to moderate very fine and fine granular; friable; neutral; clear wavy boundary.

Bwb—30 to 40 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to moderate fine angular blocky; firm; many very fine yellowish red (5YR 4/6) concretions; slightly acid; clear wavy boundary.

Cg1—40 to 45 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; many medium distinct dark brown (7.5YR 3/2) mottles; weak coarse subangular blocky structure; friable; many fine yellowish red (5YR 4/6) concretions; slightly acid; clear wavy boundary.

Cg2—45 to 60 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; massive; friable; neutral.

The solum ranges from 36 to 54 inches in thickness. The mollic epipedon is more than 36 inches thick. Together, the surface layer and C horizon that formed in recently deposited sediment are 5 to 15 inches thick and have value of 3 or 4 and chroma of 1 or 2. They are silt loam or silty clay loam and are slightly acid through mildly alkaline. The Ab horizon below the recent sediment has hue of 10YR or N, value of 2 or 3, and chroma of 0 or 1. The upper part of the Ab horizon typically is silty clay loam, but in some pedons it is silt loam. In some pedons sand or loamy sand is within a depth of 60 inches.

Comfrey Series

The Comfrey series consists of deep, poorly drained, moderately permeable soils on flood plains. These soils

formed in loamy alluvium. They are occasionally to frequently flooded. Slope ranges from 0 to 2 percent.

Comfrey soils are similar to Colo and Moundprairie soils and are associated on the landscape with Shiloh soils. Colo and Moundprairie soils are silty and are on positions similar to those of Comfrey soils. Shiloh soils are fine textured and are in depressions.

Typical pedon of Comfrey silty clay loam, channeled; 1,300 feet west and 1,200 feet north of the southeast corner of sec. 24, T. 101 N., R. 4 W.

A1—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate very fine granular structure; friable; medium acid; clear smooth boundary.
A2—8 to 19 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; slightly acid; clear smooth boundary.
A3—19 to 29 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; common fine reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; slightly acid; clear smooth boundary.
Cg1—29 to 42 inches; dark gray (5Y 4/1) loam; few fine distinct dark reddish brown (5YR 3/3) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; neutral; gradual smooth boundary.
Cg2—42 to 60 inches; dark gray (5Y 4/1) fine sandy loam; common medium prominent reddish brown (5YR 4/4) mottles; few thin strata of loamy fine sand; weak medium platy structure; friable; common black concretions; neutral.

The mollic epipedon is 24 to 36 inches thick. The A horizon has value of 2 or 3. It is loam, clay loam, silt loam, or silty clay loam and is neutral through strongly acid. A B horizon is present in some pedons. The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It typically is loam or clay loam in the upper part, but coarser textures are common below a depth of 40 inches. The C horizon is slightly acid or neutral.

Council Series

The Council series consists of deep, well drained, moderately permeable soils on foot slopes below very steep side slopes of upland ridges. These soils formed in loamy colluvium. Slope ranges from 12 to 30 percent.

Council soils are similar to Eyota soils and are associated on the landscape with Elbaville, Plainfield, and Seaton soils. All of these soils are on landscape positions similar to those of Council soils. Elbaville soils have loamy-skeletal colluvium at a depth between 20 and 40 inches. Eyota soils have a mollic epipedon. Plainfield soils have a sandy mantle. Seaton soils are fine-silty.

Typical pedon of Council fine sandy loam, 20 to 30 percent slopes; 1,680 feet north and 1,260 feet east of the southwest corner of sec. 29, T. 104 N., R. 7 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.
E1—3 to 7 inches; dark grayish brown (10YR 4/2) sandy loam; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.
E2—7 to 14 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine subangular blocky structure; very friable; moderately thick grayish brown (10YR 5/2) silt coatings on faces of peds; strongly acid; abrupt wavy boundary.
Bt1—14 to 23 inches; yellowish brown (10YR 5/4) sandy loam; brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; friable; few patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; medium acid; clear smooth boundary.
Bt2—23 to 29 inches; yellowish brown (10YR 5/4) loam; common dark yellowish brown (10YR 4/4) coatings on faces of peds; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; about 3 percent cobbles of dolomite; medium acid; clear smooth boundary.
Bt3—29 to 40 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; friable; few thin very dark grayish brown (10YR 3/2) clay films on faces of peds; medium acid; clear smooth boundary.
BC—40 to 54 inches; yellowish brown (10YR 5/4) loam; weak coarse subangular blocky structure; friable; slightly acid; clear smooth boundary.
C—54 to 60 inches; yellowish brown (10YR 5/4) loam; few cleavage planes; friable; neutral.

The solum is 40 to 70 inches thick. The A horizon is 1 inch to 4 inches thick. It has value of 2 or 3 and chroma of 1 or 2. The E horizon is 3 to 12 inches thick. It has value of 4 or 5 and chroma of 2 or 3. The A and E horizons are sandy loam, fine sandy loam, very fine sandy loam, or loam. They range from neutral through medium acid. The Bt horizon has value and chroma of 4 or 5. It is fine sandy loam, sandy loam, or silt loam in the upper part and loam or silt loam in the lower part. The Bt horizon is slightly acid through strongly acid. The C horizon has value of 5 or 6 and chroma of 3 through 5. It is loam or silt loam and is medium acid through neutral.

Dickinson Series

The Dickinson series consists of deep, well drained and somewhat excessively drained soils on stream terraces. These soils formed in a mantle of loamy sediment and the underlying sand. Permeability is moderately rapid. Slope ranges from 1 to 6 percent.

Dickinson soils are associated on the landscape with Billett, Plainfield, and Sparta soils. These soils are on landscape positions similar to those of Dickinson soils. Billett soils do not have a mollic epipedon. Plainfield and Sparta soils are sandy.

Typical pedon of Dickinson sandy loam, 1 to 6 percent slopes; 2,580 feet east and 1,750 feet south of the northwest corner of sec. 26, T. 104 N., R. 6 W.

Ap—0 to 12 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; slightly acid; clear smooth boundary.

AB—12 to 22 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on faces of peds; weak very fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

Bw—22 to 34 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; medium acid; clear smooth boundary.

BC—34 to 37 inches; dark yellowish brown (10YR 4/4) loamy sand; single grain; very friable; strongly acid; clear smooth boundary.

C—37 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slightly acid.

Thickness of the solum ranges from 24 to 50 inches. Depth to loamy sand or sand ranges from 20 to 36 inches.

The A horizon has chroma of 2 or 3 and value of 1 or 2. It is sandy loam or loam. The upper part of the B horizon has chroma of 3 or 4, and the lower part has value and chroma of 4 or 5. The B horizon is medium acid or strongly acid. The C horizon has value of 4 or 5 and chroma of 3 through 6. It is sand or loamy sand and is slightly acid or medium acid.

Dorerton Series

The Dorerton series consists of deep, well drained, moderately permeable soils on hillsides in dissected uplands. These soils formed in loess and the underlying loamy-skeletal colluvium. Slope ranges from 30 to 45 percent.

The Dorerton soils in Houston County are mapped only in complex with Lamoille soils. Dorerton soils are also associated on the landscape with Lacrescent soils. Lamoille soils have a clayey subsoil and are on positions similar to those of Dorerton soils. Lacrescent soils have a mollic epipedon and are on steeper positions downslope.

Typical pedon of Dorerton silt loam, in an area of Lamoille-Dorerton silt loams, 30 to 45 percent slopes; 350 feet east and 1,650 feet north of the southwest corner of sec. 32, T. 104 N., R. 7 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; neutral; abrupt wavy boundary.

E—3 to 6 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; dark grayish brown (10YR 4/2) coatings on faces of peds; slightly acid; clear smooth boundary.

Bt1—6 to 11 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; dark brown (10YR 3/3) coatings on faces of peds; few thin dark brown (7.5YR 3/2) clay films; about 5 percent coarse fragments; slightly acid; clear irregular boundary.

2Bt2—11 to 18 inches; brown (10YR 4/3) cobbly loam; moderate very fine and fine subangular blocky structure; friable; dark brown (10YR 3/3) coatings on faces of peds; about 40 percent coarse fragments; few thin dark brown (7.5YR 3/2) clay films; slightly acid; clear wavy boundary.

2Bt3—18 to 25 inches; dark yellowish brown (10YR 4/4) very cobbly loam; moderate very fine and fine subangular blocky structure; friable; few clay films; about 50 percent cobble and gravel size fragments; neutral; clear irregular boundary.

2C—25 to 60 inches; yellowish brown (10YR 5/4) very cobbly loam; weak fine subangular blocky structure; very friable; about 50 percent cobble and gravel size fragments; strong effervescence; moderately alkaline.

The thickness of the solum is 24 to 45 inches. Depth to free carbonates is 18 to 40 inches. Thickness of the loess mantle is 10 to 20 inches. The loess mantle contains 0 to 10 percent coarse fragments. The 2Bt and 2C horizons have 35 to 70 percent cobble and gravel size dolomite fragments. Dolomite bedrock begins at a depth ranging from 40 to 80 inches or more.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is neutral or slightly acid. The E horizon has value of 3 through 5 and chroma of 2 or 3. It is slightly acid through strongly acid. The B horizon has value of 4 or 5 and chroma of 3 or 4. It is slightly acid or medium acid. The 2B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The fine earth fraction in the 2B horizon is loam or clay loam and is slightly acid or neutral. The 2C horizon has value of 4 through 6 and chroma of 3 or 4. The fine earth fraction in the 2C

horizon is loam, fine sandy loam, or sandy loam. It is mildly alkaline or moderately alkaline.

Edmund Series

The Edmund series consists of moderately deep, well drained soils on summits and the upper part of hillsides in the uplands. These soils formed in a mantle of loess and the underlying clayey and clayey-skeletal residuum weathered from limestone. Permeability is moderately slow. Slope ranges from 4 to 20 percent.

The Edmund soils in Houston County are outside the range defined for the series because depth to solid bedrock ranges from 20 to 40 inches and the content of coarse fragments is slightly too high. These differences, however, do not affect the usefulness or behavior of the soils.

Edmund soils are similar to and are associated on the landscape with Frankville and Sogn soils. These soils are on positions similar to those of Edmund soils. Frankville soils formed in a thicker silty mantle than Edmund soils, and Sogn soils are loamy.

Typical pedon of Edmund silt loam, 4 to 12 percent slopes, eroded; 975 feet north and 1,335 feet west of the southeast corner of sec. 25, T. 101 N., R. 7 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium granular structure parting to moderate fine granular; very friable; very dark gray (10YR 3/2) coatings on faces of peds; few masses of brown (10YR 5/3) in the lower part; slightly acid; clear wavy boundary.

BA—9 to 14 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium angular blocky structure parting to moderate fine angular blocky; very friable; common fine coatings of silt on faces of peds; slightly acid; abrupt wavy boundary.

2Bt1—14 to 20 inches; dark brown (7.5YR 4/4) silty clay; strong medium angular blocky structure parting to strong fine angular blocky; firm; dark brown (7.5YR 4/2) coatings on faces of peds; common moderately thick dark brown (10YR 3/3) clay films on faces of peds; neutral; abrupt wavy boundary.

2Bt2—20 to 36 inches; dark brown (7.5YR 4/4) very flaggy silty clay; about 90 percent limestone fragments; clay films surrounding coarse fragments; strong effervescence; clear wavy boundary.

3R—36 to 60 inches; light gray (10YR 7/2) hard limestone bedrock.

The loess mantle is 6 to 15 inches thick. The thickness of the solum and depth to bedrock range from 20 to 40 inches. The loess mantle has less than 5 percent coarse fragments. The 2B horizon has 0 to 20 percent coarse fragments in the upper part and 75 to 95 percent coarse fragments in the lower part. The fragments are mostly flagstones with some channers.

The A horizon has value of 2 or 3 and chroma of 1 through 3. It is silt loam, silty clay loam, or silty clay. The part of the B horizon that formed in loess has value and chroma of 3 or 4. It is medium acid through neutral. The 2Bt1 horizon typically is 3 to 8 inches thick. It has hue of 5YR through 10YR, value of 3 or 4, and chroma of 3 through 6. This horizon typically is silty clay but is silty clay loam in the upper part of some pedons. It is neutral through medium acid. The 2Bt2 horizon ranges from 5 to 30 inches or more in thickness. The fine earth fraction of this horizon has hue of 5YR through 2.5Y, value of 4 or 5, and chroma of 3 through 6. It is silty clay or clay and is neutral or mildly alkaline.

Eitzen Series

The Eitzen series consists of deep, well drained and moderately well drained, moderately permeable soils on narrow flood plains in the upper reaches of stream valleys. These soils formed in a mantle of silty, recent alluvial sediment overlying a buried soil. They are occasionally flooded. Slope ranges from 1 to 6 percent.

Eitzen soils are similar to Arenzville and Chaseburg soils and are associated on the landscape with Muscatine soils. Arenzville soils contain less clay and are on broader parts of the flood plain than Eitzen soils. Chaseburg soils are dark grayish brown in the surface layer and do not have a buried soil within the control section. They are typically on positions similar to those of Eitzen soils but are further downstream. Muscatine soils do not have a mantle of recent sediment and are upslope at the head of drainageways.

Typical pedon of Eitzen silt loam, occasionally flooded, in a slightly concave area that has 1 percent slope; 2,550 feet north and 360 feet west of the southeast corner of sec. 17, T. 101 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

C—8 to 25 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate thin platy structure; friable; common thin strata of dark grayish brown (10YR 4/2) very fine sandy loam; neutral; clear smooth boundary.

Ab1—25 to 38 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; friable; slightly acid; clear smooth boundary.

Ab2—38 to 48 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; friable; slightly acid; clear smooth boundary.

Btb1—48 to 55 inches; dark yellowish brown (10YR 4/4) loam; moderate coarse subangular blocky structure; friable; few thin brown (10YR 4/3) clay films on faces of peds; medium acid; clear smooth boundary.
Btb2—55 to 60 inches; yellowish brown (10YR 5/4) silt loam; moderate coarse subangular blocky structure; very friable; few thin dark yellowish brown (10YR 4/4) clay films on faces of peds; few thin light gray (10YR 7/2) coatings of clean sand and silt particles on faces of peds; medium acid.

The thickness of the recent alluvial sediment and depth to the buried soil range from 20 to 36 inches. Depth to free carbonates is more than 60 inches.

The Ap horizon has value and chroma of 2 or 3. It is medium acid through neutral. The C horizon has dominant value of 2 or 3 but has strata that have value of 3 through 5 and chroma of 2 or 3. The C horizon is mainly silt loam, but the strata are loam, very fine sandy loam, or loamy very fine sand. This horizon is medium acid through neutral. The Ab horizon has value of 2 or 3 and chroma of 1 or 2. It is medium acid through neutral. The Bb horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It has mottles in some pedons. This horizon is silt loam or loam and has 0 to 5 percent coarse fragments. It is slightly acid through strongly acid. A 2Bb horizon, 2C horizon, or both horizons are below a depth of 60 inches in some pedons. These horizons have a sandy texture and 0 to 10 percent coarse fragments.

Elbaville Series

The Elbaville series consists of deep, well drained soils on foot slopes below very steep hillsides in uplands. These soils formed in a mixture of loess and loamy colluvium and the underlying loamy-skeletal colluvium. Permeability is moderately slow. Slope ranges from 20 to 45 percent.

Elbaville soils are associated on the landscape with Council, Lacrescent, Lamoille, and Seaton soils in valleys. Council and Seaton soils do not have loamy-skeletal material in the subsoil, formed in coarse-loamy colluvium and loess, respectively, and are downslope from Elbaville soils. Lacrescent soils are shallower to loamy-skeletal material and are upslope on very steep hillsides. Lamoille soils formed partly in clayey erosional sediment and are typically upslope from Elbaville soils.

Typical pedon of Elbaville silt loam, 30 to 45 percent slopes; 1,100 feet south and 1,800 feet east of the northwest corner of sec. 34, T. 102 N., R. 4 W.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine and fine subangular blocky structure; very friable; neutral; clear smooth boundary.
E—5 to 12 inches; brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) dry; dark grayish brown (10YR 5/2) coatings on faces of peds; weak fine platy structure parting to weak very fine subangular blocky; very friable; neutral; clear smooth boundary.
B/E—12 to 16 inches; dark yellowish brown (10YR 4/4) silt loam (B); common interfingering of dark grayish brown (10YR 4/2) (E); weak fine subangular blocky structure parting to moderate very fine subangular blocky; very friable; medium acid; clear smooth boundary.
Bw—16 to 22 inches; dark yellowish brown (10YR 4/4) silt loam; thin dark brown (10YR 4/3) coatings on faces of peds; moderate fine and medium angular blocky structure; friable; medium acid; clear smooth boundary.
2Bt—22 to 31 inches; dark brown (7.5YR 4/4) gravelly clay loam; strong medium angular blocky structure parting to strong fine and very fine angular blocky; firm; common moderately thick very dark grayish brown (10YR 3/2) clay films in tubular pores; about 15 percent coarse fragments, mostly pebbles; medium acid; clear smooth boundary.
3C1—31 to 42 inches; yellowish brown (10YR 5/4) very cobbly loam; weak fine and medium subangular blocky structure; friable, few moderately thick very dark grayish brown (10YR 3/2) clay films in tubular pores; about 60 percent coarse fragments, mostly cobblestones and some pebbles; slight effervescence; mildly alkaline; clear smooth boundary.
3C2—42 to 60 inches; light olive brown (2.5Y 5/3) cobbly fine sandy loam; weak very fine subangular blocky structure; very friable; about 55 percent coarse fragments, mostly cobbles and some pebbles; slight effervescence; mildly alkaline.

The thickness of the solum and depth to free carbonates range from 30 to 60 inches. The thickness of the loamy or silty colluvium is 15 to 30 inches. Depth to pale brown, coarse grained sandstone of the Jordan Formation or greenish gray, fine grained, glauconitic sandstone of the Franconia Formation ranges from 60 to 120 inches or more. The silty or loamy colluvium contains 0 to 5 percent coarse fragments. The 2B horizon has 0 to 20 percent coarse fragments, and the 3C horizon has 35 to 70 percent coarse fragments. Fragments range from pebbles to cobblestones in size and are dolomitic.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has chroma of 2 or 3. The A and E horizons are fine sandy loam, loam, or silt loam. They are neutral through medium acid. The Bw horizon in the upper sediment has value of 4 or 5 and chroma of 3 or 4. It is silt loam or loam and is neutral through strongly acid. The 2B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. The fine earth fraction in this horizon is clay loam or clay and is medium acid or strongly acid. The 3C horizon has hue of 10YR or 2.5Y,

value of 5 or 6, and chroma of 3 or 4. The fine earth fraction in the 3C horizon is fine sandy loam or loam and is mildly alkaline or moderately alkaline.

Eleva Series

The Eleva series consists of moderately deep, well drained and somewhat excessively drained soils. These soils are on low narrow upland ridges that extend into valleys from very steep hillsides at a higher elevation. They formed in sandy residuum weathered from sandstone of the Dresbach and Jordan Formations. Permeability is moderately rapid. Slope ranges from 20 to 45 percent.

The Eleva soils in Houston County are outside the range defined for the Eleva series because they do not have an argillic horizon and contain slightly less clay in the profile. These differences, however, do not affect the usefulness or behavior of the soils.

Eleva soils are associated on the landscape with and are similar to Etter and Norden soils. These soils are on positions similar to those of Eleva soils. Etter soils have a mollic epipedon. Norden soils are fine-loamy and formed in loamy glauconitic residuum weathered from the Franconia Formation.

Typical pedon of Eleva sandy loam, 30 to 45 percent slopes; 580 feet north and 2,300 feet east of the southwest corner of sec. 15, T. 104 N., R. 6 W.

A—0 to 3 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; very friable; strongly acid; clear smooth boundary.

E—3 to 12 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) sandy loam, light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; strongly acid; clear smooth boundary.

Bt1—12 to 20 inches; dark brown (10YR 4/3) sandy loam; weak fine and medium subangular blocky structure; very friable; thin dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) clean sand grains on faces of peds; few thin clay films; about 5 percent channery sandstone fragments; strongly acid; clear smooth boundary.

Bt2—20 to 31 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium blocky structure; very friable; light brownish gray (10YR 6/2) clean sand grains on faces of peds; about 5 percent channery sandstone fragments; strongly acid; clear smooth boundary.

Cr—31 to 60 inches; yellowish brown (10YR 5/6) soft sandstone; medium acid.

The thickness of the solum and the depth to soft sandstone range from 20 to 35 inches. The lower part of the solum has 2 to 15 percent channers of sandstone. The soil is medium acid or strongly acid throughout.

The A horizon has value of 2 or 3. It is sandy loam or loam. The E horizon has value of 3 through 5 and chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 3 through 5. It is sandy loam or fine sandy loam. In some pedons a C horizon is present.

Etter Series

The Etter series consists of deep, well drained soils on side slopes of ridges and mesas in uplands. These soils formed in a mixture of loess and sandstone residuum from St. Peter sandstone. Permeability is moderate in the surface layer and subsoil and rapid in the underlying material. Slope ranges from 25 to 50 percent.

The Etter soils in Houston County are mapped only in complex with Brodale soils. They are associated on the landscape with Brodale and Eyota soils and are similar to Eleva soils. Brodale soils are underlain by limestone and are upslope from Etter soils. Eyota soils are on foot slopes and are more than 40 inches deep to sandstone. Eleva soils are on positions similar to those of Etter soils but have a grayish brown surface layer.

Typical pedon of Etter sandy loam, in an area of Etter-Brodale complex, rocky, 25 to 50 percent slopes; on a south-facing slope, 450 feet north and 2,025 feet east of the southwest corner of sec. 35, T. 102 N., R. 7 W.

A—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; very friable; common very fine roots; about 5 percent channers of limestone; medium acid; clear smooth boundary.

Bw—8 to 17 inches; brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; very friable; common fine roots; about 5 percent sandstone fragments; medium acid; clear smooth boundary.

2BC—17 to 22 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine granular structure; very friable; about 5 percent sandstone fragments; medium acid; clear smooth boundary.

2C—22 to 60 inches; pale brown (10YR 6/3), light yellowish brown (10YR 6/4), and light brownish gray (10YR 6/2) fine sand; slightly acid.

The thickness of the solum is 20 to 40 inches. The content of limestone channers and flagstones ranges from 0 to 10 percent. The mollic epipedon is 8 to 20 inches thick.

The A horizon has value of 2 or 3. It is sandy loam or loam but is typically loam in some pedons near the upper part of the slope. The A horizon is slightly acid or medium acid. The upper part of the B horizon has value and chroma of 3 or 4. It is slightly acid or medium acid. The 2B horizon has value and chroma of 4 or 5. The 2C horizon is sand or fine sand.

Eyota Series

The Eyota series consists of deep, well drained soils on foot slopes below very steep sides of narrow ridges and mesalike hills. These soils formed in a mantle of colluvium weathered mainly from St. Peter or Jordan sandstone and the underlying sediment derived, at least partly, from loess. They are moderately permeable. Slope ranges from 12 to 20 percent.

Eyota soils are associated on the landscape with Lindstrom and Plainfield soils. These soils are on positions similar to those of Eyota soils. Lindstrom soils are silty, and Plainfield soils contain more sand and are typically upslope.

Typical pedon of Eyota sandy loam, 12 to 20 percent slopes; 1,900 feet west and 325 feet north of the southeast corner of sec. 28, T. 102 N., R. 6 W.

A1—0 to 33 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

A2—33 to 38 inches; very dark brown (10YR 2/2) sandy loam; dark grayish brown (10YR 4/2) dry; weak to moderate medium subangular blocky structure; very friable; strongly acid; clear smooth boundary.

2BA—38 to 43 inches; brown (10YR 4/3) loam; weak to moderate coarse to medium subangular blocky structure; friable; very dark grayish brown (10YR 3/2) coatings on faces of peds; strongly acid; clear smooth boundary.

2Bt—43 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; brown (10YR 4/3) coatings on faces of peds; common thin dark brown (10YR 3/3) clay films on faces of peds and in pores; strongly acid.

The solum is 40 to 70 inches thick. The mollic epipedon is 24 to 48 inches thick. The coarse-loamy mantle is typically 25 to 50 inches thick and overlies sediment that is higher in content of clay and silt and lower in content of sand.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly sandy loam but in some pedons has loamy sand subhorizons as much as 15 inches thick. A 2A horizon of loam or silt loam is in some pedons. The A horizons are slightly acid through strongly acid. The 2B horizon has value and chroma of 3 through 5. It is medium acid or strongly acid. A 3C horizon of soft sandstone is at a depth as shallow as 50 inches in some pedons.

Festina Series

The Festina series consists of deep, well drained, moderately permeable soils on flats and side slopes of terraces in valleys. These soils formed in silty alluvium derived from loess. Slope ranges from 0 to 12 percent.

Festina soils are associated on the landscape with Bertrand and Walford soils and are similar to Mt. Carroll soils. Bertrand soils are underlain by sand within a depth of 60 inches and are on positions similar to those of Festina soils. Mt. Carroll soils formed in loess and are on uplands. Walford soils are poorly drained and are on slightly lower positions.

Typical pedon of Festina silt loam, 2 to 6 percent slopes; 1,075 feet north and 1,350 feet west of the southeast corner of sec. 25, T. 102 N., R. 5 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine and very fine roots; slightly acid; abrupt smooth boundary.

BA—8 to 13 inches; brown (10YR 4/3) silt loam; moderate fine subangular blocky structure; friable; many fine and very fine roots; common thin coatings of grayish brown (10YR 5/2) sand and silt particles on faces of peds; slightly acid; clear smooth boundary.

Bt1—13 to 22 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common very fine and fine roots; few thin to moderately thick very dark grayish brown (10YR 3/2) clay films in pores and on faces of peds; slightly acid; clear smooth boundary.

Bt2—22 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; friable; common fine roots; common fine and very fine tubular pores; few thin to moderately thick very dark grayish brown (10YR 3/2) clay films in pores and on faces of peds; medium acid; clear smooth boundary.

Bt3—28 to 36 inches; olive brown (2.5Y 4/4) silt loam; few fine distinct grayish brown (2.5Y 5/2) mottles; moderate coarse subangular blocky structure; friable; common fine roots and tubular pores; few thin to moderately thick very dark grayish brown (10YR 3/2) clay films in pores and on faces of peds; medium acid; clear smooth boundary.

BC—36 to 60 inches; olive brown (2.5Y 4/4) silt loam; common fine distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; few fine roots and tubular pores; medium acid.

Thickness of solum typically is 40 to 72 inches but ranges to as shallow as 36 inches in some sloping areas. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. In areas that are not cultivated, an A horizon ranging from 3 to 8 inches and an E horizon ranging from 4 to 6 inches in thickness are present. The B

horizon has hue of 10YR in the upper part and 10YR or 2.5Y in the lower part. It has value of 4 or 5 and chroma of 3 or 4 in the upper part and 2 through 5 in the lower part. The B horizon does not have mottles, or it has high chroma mottles, low chroma mottles, or both of these in the lower part. The B horizon is silt loam or silty clay loam, commonly has evidence of textural stratification, and is medium acid or slightly acid.

In Houston County, Festina silt loam, 6 to 12 percent slopes, eroded, is outside the range defined for the Festina series because it does not have a dark colored surface layer. This difference, however, does not alter the usefulness or behavior of the soil.

Frankville Series

The Frankville series consists of deep, well drained soils on upland ridges. These soils formed in a mantle of loess and the underlying clayey residuum and clayey-skeletal residuum weathered from limestone. They are moderately permeable in the loess and slowly permeable in the clayey residuum. Slope ranges from 3 to 20 percent.

The Frankville soils in Houston County are outside the range described for the Frankville series because solid bedrock is slightly below a depth of 40 inches. This difference, however, does not alter the usefulness or behavior of the soils.

Frankville soils are associated on the landscape with Edmund, Massbach, and Nasset soils. These soils are on landscape positions similar to those of Frankville soils. Edmund soils formed in a thinner mantle of loess than Frankville soils, Massbach soils are underlain by shale, and Nasset soils formed in a thicker mantle of loess.

Typical pedon of Frankville silt loam, 6 to 12 percent slopes, eroded; 2,100 feet east and 400 feet south of the northwest corner of sec. 23, T. 102 N., R. 6 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; very dark grayish brown (10YR 3/2) masses, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; friable; medium acid; clear smooth boundary.

AB—8 to 12 inches; very dark brown (10YR 2/2) and dark yellowish brown (10YR 4/4) silt loam; few dark grayish brown (10YR 4/2) masses; brown (10YR 4/3) rubbed; pale brown (10YR 6/3) dry; moderate fine subangular blocky structure; friable; medium acid; clear smooth boundary.

Bt1—12 to 22 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; dark grayish brown (10YR 4/2) and brown (10YR 4/3) coatings on faces of peds; few thin light gray (10YR 7/1) coatings of silt and very fine sand on faces of peds; medium acid; clear smooth boundary.

Bt2—22 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; dark grayish brown (10YR 4/2) coatings of silt and very fine sand on faces of peds; common thin and moderately thick brown (10YR 4/3) clay films on faces of peds; medium acid; clear smooth boundary.

2Bt3—28 to 35 inches; dark brown (7.5YR 4/4) silty clay; few strong brown (7.5YR 5/6) masses; weak coarse prismatic structure parting to strong fine angular blocky; firm; continuous thick dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) clay films in fine pores; medium acid; clear smooth boundary.

2Bt4—35 to 48 inches; dark brown (7.5YR 4/4) very flaggy silty clay; about 90 percent flagstones in silty clay matrix and clay films surrounding fragments; massive; firm; strong effervescence; mildly alkaline; clear smooth boundary.

2R—48 to 60 inches; fractured limestone bedrock.

Clayey-skeletal material is at a depth of 20 to 48 inches. Hard bedrock is at a depth of 40 to 80 inches. The loess mantle is 18 to 36 inches thick. The upper part of the 2B horizon has 0 to 10 percent coarse fragments. The lower part of the 2B horizon has 75 to 90 percent channers and flagstones of limestone.

The A horizon has value of 2 or 3 and chroma of 1 or 2. An E horizon 3 to 5 inches thick is in some pedons. The A and E horizons are neutral through medium acid. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It typically is silt loam but is silty clay loam in the lower part of some pedons. The fine earth part of the 2Bt horizon has hue of 7.5YR or 10YR and value and chroma of 4 through 6. The silty clay or clay constitutes 5 to 25 percent of the horizon. It is neutral or mildly alkaline.

Gotham Series

The Gotham series consists of deep, well drained and somewhat excessively drained, rapidly permeable soils on terraces along the Root River. These soils formed in sandy alluvium. Slope ranges from 2 to 10 percent.

Gotham soils are similar to and are commonly associated on the landscape with Billett, Dickinson, Plainfield, and Sparta soils. Billett and Dickinson soils are coarse-loamy. Plainfield and Sparta soils do not have an argillic horizon. All of these soils are in positions similar to those of Gotham soils.

Typical pedon of Gotham loamy sand, 2 to 10 percent slopes; 2,800 feet west and 300 feet north of the southeast corner of sec. 29, T. 104 N., R. 6 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy sand, brown (10YR 5/3) dry; weak very fine subangular

blocky structure; very friable; slightly acid; clear smooth boundary.
E—9 to 14 inches; brown (10YR 4/3) loamy sand; weak very fine and fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
BA—14 to 25 inches; dark yellowish brown (10YR 4/4) loamy sand; weak very fine granular structure; very friable; slightly acid; clear smooth boundary.
Bt—25 to 32 inches; yellowish brown (10YR 5/4) and dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; thin clay films bridging sand grains; medium acid; clear smooth boundary.
C—32 to 60 inches; yellowish brown (10YR 5/4) sand; thin lamellae of dark brown (7.5YR 4/4) sand and loamy sand 1/2 to 1 inch thick, spaced about 5 to 10 inches apart; weak very fine subangular blocky structure in lamellae and single grain in sand; very friable or loose; few thin clay films as bridges on lamellae; medium acid.

The solum is 30 to 40 inches thick. The A or Ap horizon has value and chroma of 2 or 3. It is loamy sand or loamy fine sand. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 through 6. It is loamy sand and has a distinct increase in clay over the horizon above. The Bt horizon is neutral through strongly acid. The C horizon has value of 4 through 6 and chroma of 3 through 6. It is loamy sand or sand and is neutral through strongly acid.

Huntsville Series

The Huntsville series consists of deep, well drained and moderately well drained, moderately permeable soils on flood plains. These soils formed in silty alluvial sediment. They are subject to occasional flooding. Slope ranges from 0 to 2 percent.

Huntsville soils are associated on the landscape with Arenzville, Beavercreek, Comfrey, and Newalbin soils. Arenzville soils formed partly in a thick mantle of recently deposited silty erosional sediment. They are on positions similar to those of Huntsville soils. Beavercreek soils formed in a thin mantle of loamy alluvium and are commonly upstream from Huntsville soils. Comfrey soils are poorly drained and are on lower lying positions. Newalbin soils formed in a thick mantle of recently deposited silty erosional sediment, are poorly drained, and are on lower lying positions.

Typical pedon of Huntsville silt loam, occasionally flooded; 920 feet west and 2,400 feet north of the southeast corner of sec. 26, T. 102 N., R. 5 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.
A1—9 to 19 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; neutral; clear smooth boundary.
A2—19 to 33 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.
C1—33 to 45 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
C2—45 to 55 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
C3—55 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; neutral.

The mollic epipedon is 24 to 48 inches thick. The A horizon has value of 2 or 3 and chroma of 1 or 2. The C horizon has value of 3 through 5. Mottles are in some pedons below a depth of 30 inches.

The Huntsville soil in Huntsville-Beavercreek silt loams, channeled, is outside the range for the series because the mollic epipedon is too thick and the soil contains more sand than defined for the series. These differences, however, do not alter the usefulness or behavior of the soil.

Kalmarville Series

The Kalmarville series consists of deep, poorly drained soils on flood plains. These soils formed in stratified sandy and loamy alluvium. They are occasionally flooded. Permeability is moderately rapid in the solum and rapid in the underlying material. Slope is 0 to 1 percent.

The Kalmarville soils in Houston County are outside the range defined for the Kalmarville series because they are moderately deep to sand and do not have fine stratification. These differences, however, do not alter the usefulness or behavior of the soils.

Kalmarville soils are associated on the landscape with Minneiska and Moundprairie soils. Minneiska soils are moderately well drained and are on the slightly higher positions. Moundprairie soils are silty and are on positions similar to those of the Kalmarville soils.

Typical pedon of Kalmarville silty clay loam, occasionally flooded; 1,850 feet east and 1,025 feet north of the southwest corner of sec. 29, T. 104 N., R. 4 W.

A1—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common fine distinct dark brown (7.5YR 4/4) mottles; thin strata of silt loam; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A2—10 to 18 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; common fine distinct dark brown (7.5YR 4/4) mottles; weak very fine and fine subangular blocky structure; friable; neutral; clear smooth boundary.
A3—18 to 22 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 5/1) dry; common fine distinct dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; very friable; weak effervescence; mildly alkaline; clear smooth boundary.
A4—22 to 27 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 5/1) dry; common medium and coarse distinct olive brown (10YR 4/4) and common fine distinct dark gray (10YR 4/1) mottles; weak fine subangular blocky structure; very friable; strong effervescence; mildly alkaline; clear smooth boundary.
C—27 to 60 inches; stratified gray (10YR 5/1) sand and loamy fine sand and dark gray (10YR 4/1) fine sandy loam; many fine and medium distinct olive brown (2.5Y 4/4) and few fine prominent light olive brown (2.5Y 5/6) mottles; single grain; massive; loose in the fine sand and loamy fine sand and very friable in the fine sandy loam; slight effervescence in upper part and strong effervescence in lower part; mildly alkaline.

The thickness of the solum and depth to sandy alluvium range from 20 to 35 inches. The A horizon has as much as 15 inches of recently deposited erosional sediment. It is silty clay loam, clay loam, silt loam, loam, or fine sandy loam. The A horizon is neutral or mildly alkaline. It has value of 2 or 3 and chroma of 0 or 1. The C horizon has hue of 10YR through 2.5Y, value of 4 or 5, and chroma of less than 2. It is dominantly stratified loamy fine sand or sand 1 to 15 inches thick, but some thin strata are loamy.

Kennebec Series

The Kennebec series consists of deep, moderately well drained, moderately permeable soils on flood plains along the Root River and small tributary streams. These soils formed in silty alluvium. They are subject to occasional flooding. Slope is less than 1 percent.

Kennebec soils are associated on the landscape with Colo, Rawles, and Terril soils. Colo soils are poorly drained and are on the lower positions. Rawles soils do not have a mollic epipedon and typically are on the slightly lower positions. Terril soils are well drained and typically are on the slightly higher positions.

Typical pedon of Kennebec silt loam, occasionally flooded; 1,250 feet north and 2,280 feet west of the southeast corner of sec. 26, T. 104 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.
A1—8 to 12 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; thin strata of grayish brown (10YR 5/2) sand, light gray (10YR 7/2) dry; weak very thin platy structure; friable; neutral; clear smooth boundary.
A2—12 to 36 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
A3—36 to 48 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; very dark brown (10YR 2/2) coatings on faces of peds; neutral; gradual smooth boundary.
C—48 to 60 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine prismatic structure parting to moderate medium subangular blocky; friable; very dark grayish brown (10YR 3/2) coatings on faces of peds; neutral.

The solum and mollic epipedon are typically more than 36 inches thick. The Ap or A horizon consists of recently deposited sediment as much as 15 inches thick. It is neutral or mildly alkaline. The lower part of the A horizon has chroma of 1 or 2. An AC horizon is in some pedons. The C horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 through 3. It is silt loam or silty clay loam in the upper part and ranges from silty clay loam through sandy loam in the lower part. It is neutral or slightly acid.

Lacrescent Series

The Lacrescent series consists of deep, well drained soils on moderately steep and very steep convex hillsides in dissected uplands (fig. 15). These soils formed in a thin mantle of loess or a mixture of loess and loamy colluvium and in loamy-skeletal colluvial sediment from dolomite. Slope ranges from 20 to 70 percent.

Lacrescent soils are similar to Brodale soils and are associated on the landscape with Brodale and Lamoille soils. Brodale soils are on positions similar to those of Lacrescent soils but are shallower to carbonates. Lamoille soils have an argillic horizon formed in clayey erosional sediment and are upslope from Lacrescent soils.

Typical pedon of Lacrescent cobbly silty clay loam, 45 to 70 percent slopes; 80 feet north and 820 feet west of the southeast corner of sec. 27, T. 103 N., R. 6 W.

A—0 to 10 inches; black (10YR 2/1) cobbly silty clay loam, dark gray (10YR 4/1) dry; moderate fine and very fine subangular blocky structure; very friable;

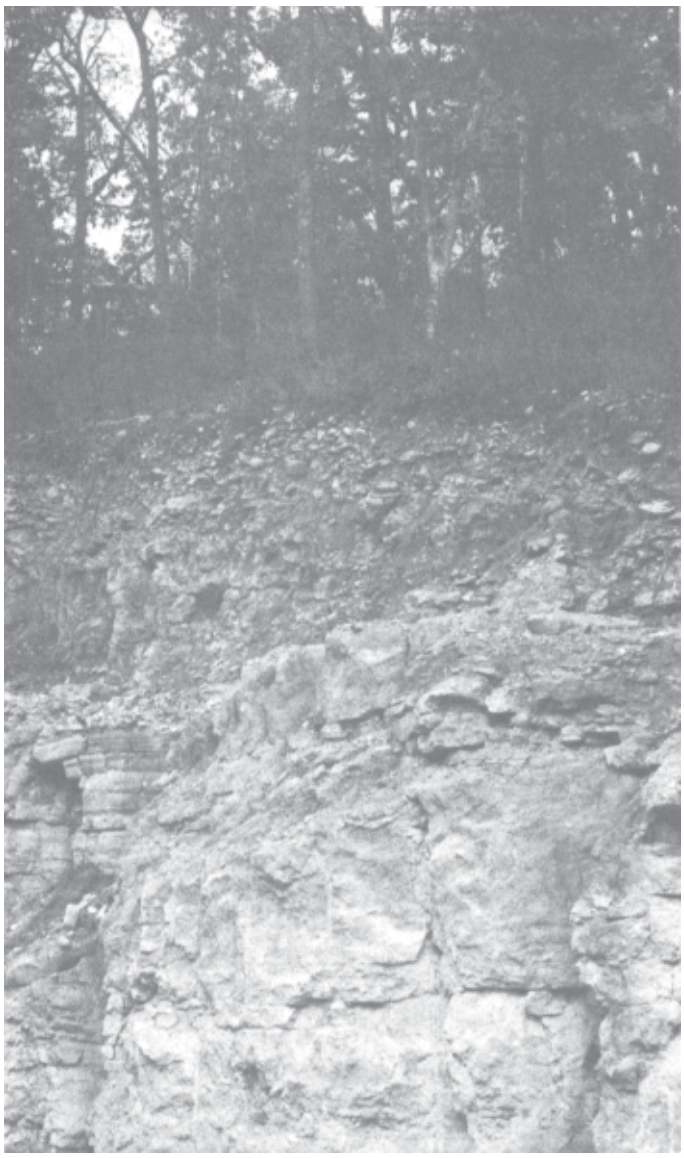

Figure 15.—Profile of Lacrescent flaggy silt loam, 20 to 35 percent slopes, overlying Oneota dolomite.

common very fine to medium tree roots; about 20 percent cobbles and pebbles; neutral; clear smooth boundary.

AB—10 to 17 inches; very dark grayish brown (10YR 3/2) cobbly silt loam, grayish brown (10YR 5/2) dry; small masses of black (10YR 2/1) and dark brown (10YR 4/3); moderate fine subangular blocky structure; very friable; common very fine to medium tree roots; about 25 percent cobbles and pebbles; neutral; clear wavy boundary.

2Bw—17 to 28 inches; dark brown (10YR 4/3) very cobbly silt loam; few small masses of dark grayish brown (10YR 3/2); weak fine subangular blocky structure; very friable; few fine and medium tree roots; about 50 percent cobbles and pebbles; neutral; clear smooth boundary.

2C—28 to 60 inches; light olive brown (2.5Y 5/3) very cobbly silt loam; massive; very friable; few fine and medium tree roots in upper part; about 50 percent cobbles and pebbles; slight effervescence; mildly alkaline.

Thickness of the solum and depth to free carbonates typically are 20 to 30 inches but range from 18 to 35 inches. The upper sediment is 5 to 20 inches thick. Depth to bedrock commonly is 5 to 8 feet but ranges from 3 1/2 to 10 feet. Content of coarse fragments ranges from 0 to 35 percent in the upper sediment and from 35 to 70 percent in the lower sediment. The coarse fragments are mostly dolomitic limestone. They are typically cobbles and pebbles, but flagstones are dominant in some pedons. The mollic epipedon is 10 to 20 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 through 3. The fine earth fraction in the A horizon is silt loam, loam, or silty clay loam. It is slightly acid or neutral. The 2B horizon has chroma of 3 or 4. The fine earth fraction in the 2B horizon typically is loam but ranges to fine sandy loam, sandy loam, or silt loam. It is slightly acid or neutral. Part of the B horizon is in the upper sediment in some pedons. The 2C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. The fine earth fraction of the 2C horizon is silt loam, loam, or fine sandy loam and is mildly alkaline or moderately alkaline.

La Farge Series

The La Farge series consists of deep, well drained moderately permeable soils on uplands. These soils are on the summits and side slopes of low narrow upland ridges that extend into valleys from very steep hillsides on higher elevations. They formed in a mantle of loess and the underlying loamy residuum or erosional sediment from Franconia sandstone. Slope ranges from 12 to 20 percent.

The La Farge soils in Houston County are outside the range of the La Farge series because they are slightly more than 40 inches to bedrock and contain slightly more coarse fragments. These differences, however, do not alter the usefulness and behavior of the soils.

La Farge soils are associated on the landscape with Council, Norden, and Seaton soils. Council soils formed in a coarse-loamy mantle and the underlying loess and are on foot slopes. Norden soils have a thinner mantle of loess than La Farge soils. Seaton soils formed entirely in loess and are on foot slopes.

Typical pedon of La Farge silt loam, 12 to 20 percent slopes, eroded; 1,875 feet south and 1,950 feet east of the northwest corner of sec. 21, T. 103 N., R. 6 W.

Ap—0 to 7 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak thin platy structure; friable; strongly acid; clear smooth boundary.
BA—7 to 12 inches; brown (10YR 4/3) silt loam; moderate medium platy structure parting to moderate very fine subangular blocky; friable; strongly acid; clear smooth boundary.
Bt1—12 to 25 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine subangular blocky structure; friable; common moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear smooth boundary.
Bt2—25 to 33 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure parting to moderate fine and very fine subangular blocky; friable; few moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear smooth boundary.
2Bt3—33 to 43 inches; light olive brown (2.5Y 5/4) loam; moderate medium prismatic structure parting to moderate fine and very fine subangular blocky; firm; about 10 percent channery glauconitic fragments; common moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear smooth boundary.
2Cr—43 to 60 inches; olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/4) sandstone; neutral.

The thickness of the solum is 30 to 60 inches. Depth to glauconitic sandstone ranges from 40 to 80 inches or more. The silty mantle is 20 to 24 inches thick. Sandstone channers make up as much as 25 percent of the lower part of the 2B horizon.

The Ap horizon has value of 3 or 4 moist and 6 or more dry and chroma of 2 or 3. In pedons that are not cultivated, an A horizon ranging from 2 to 4 inches in thickness and an E horizon ranging from 3 to 7 inches are present. The A and E horizons are neutral through strongly acid. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is medium acid through very strongly acid. The 2Bt horizon has value of 4 or 5 and chroma of 3 through 5. It is loam, sandy clay loam, or clay loam and is medium acid through very strongly acid. A 2C horizon is present in many pedons. The 2Cr horizon is weakly cemented, fine grained sandstone.

Lamoille Series

The Lamoille series consists of deep, well drained soils on steep and very steep convex side slopes of ridges in dissected uplands. These soils formed in a thin mantle of loess and in the underlying clayey erosional sediment and loamy-skeletal colluvium from dolomite. Permeability is moderate in the loess, slow in the erosion sediment, and moderately rapid in the underlying colluvium. Slope ranges from 20 to 45 percent.

Lamoille soils are associated on the landscape with Elbaville, Lacrescent, and Rollingstone soils. Elbaville soils formed partly in loamy erosional sediment and are typically downslope from Lamoille soils. Lacrescent soils have a mollic epipedon and are on steeper positions downslope. Rollingstone soils have thick clayey subsoil layers and are upslope on less sloping positions.

Typical pedon of Lamoille silt loam, in an area of Lamoille-Dorerton silt loams, 30 to 45 percent slopes; 2,450 feet west and 35 feet south of the northeast corner of sec. 16, T. 102 N., R. 6 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; very friable; many fine roots; about 1 percent pebbles, mostly dolomite; neutral; clear smooth boundary.
E—4 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light grayish brown (10YR 6/2) dry; weak thin platy structure parting to weak very fine subangular blocky; very friable; about 1 percent pebbles, mostly dolomite; neutral; clear smooth boundary.
BE—8 to 13 inches; dark brown (10YR 4/3) silt loam; weak very fine subangular blocky structure; friable; about 2 percent pebbles of chert and dolomite; neutral; clear abrupt boundary.
2Bt1—13 to 27 inches; reddish brown (5YR 4/4) clay; strong fine subangular blocky structure; firm; continuous thick dark reddish brown (5YR 3/2) clay films on faces of peds; about 15 percent pebbles of chert and cobbles of dolomite; medium acid; clear wavy boundary.
3Bt2—27 to 37 inches; brown (7.5YR 4/4) very cobbly clay loam; weak fine subangular blocky structure; continuous thin through thick dark reddish brown (5YR 3/2) clay films on faces of peds; friable; about 50 percent pebbles and cobbles of dolomite; neutral; clear smooth boundary.
3C—37 to 60 inches; yellowish brown (10YR 5/4) very cobbly loam; massive; friable; about 60 percent gravel and cobbles, mostly dolomite; slight effervescence; mildly alkaline.

The thickness of the solum and depth to free carbonates are 30 to 50 inches or more. The loess mantle is 5 to 15 inches thick. It has less than 5 percent coarse fragments. Dolomite bedrock is at a depth of 40 to 100 inches or more. The 2B horizon has 10 to 35 percent coarse fragments, and the 3B and 3C horizons have 35 to 70 percent coarse fragments. The fragments in the loess and 2B horizon are mostly pebbles and cobbles of chert. The fragments in the 3B and 3C horizons are cobbles and gravel of dolomite.

The A horizon has chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. In pedons that have been cultivated, the Ap horizon has value of 4 and chroma of 2 or 3. The A horizon is neutral or slightly acid. The 2Bt horizon has hue of 5YR or 7.5YR and value and chroma of 4 through 6. It is clay or clay loam

with 35 to 65 percent clay and is medium acid or strongly acid. The 3B horizon typically has hue of 7.5YR and less commonly 5YR, value of 4 or 5, and chroma of 4 through 6. The fine earth fraction in the 3B horizon is loam or clay loam and is medium acid through neutral. The 3C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 4 through 6. The fine earth fraction in the 3C horizon is loam or sandy loam and is mildly alkaline or moderately alkaline.

Lamont Series

The Lamont series consists of deep, well drained soils on terraces. These soils formed in loamy alluvium. Permeability is moderately rapid. Slope ranges from 1 to 70 percent.

Lamont soils are associated on the landscape with Bertrand and Billett soils. These soils are on positions similar to those of Lamont soils. Billett soils are shallower to sand. Bertrand soils have a mantle of silty sediment.

Typical pedon of Lamont fine sandy loam, 1 to 6 percent slopes; 535 feet west and 2,650 feet south of the northeast corner of sec. 4, T. 103 N., R. 6 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; medium acid; clear smooth boundary.

BA—9 to 15 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; very friable; continuous grayish brown (10YR 5/2) coatings of silt and a few very dark grayish brown (10YR 3/2) coatings on faces of peds; medium acid; clear smooth boundary.

Bt1—15 to 21 inches; yellowish brown (10YR 5/4) fine sandy loam; weak fine and medium subangular blocky structure; very friable; dark yellowish brown (10YR 4/4) coatings on faces of peds; thin continuous grayish brown (10YR 5/2) coatings and a few dark brown (10YR 3/3) thin clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—21 to 37 inches; yellowish brown (10YR 5/4) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; yellowish brown (10YR 4/4) coatings on faces of peds; few thin dark brown (10YR 3/3) clay films on faces of peds; strongly acid; clear smooth boundary.

BC—37 to 53 inches; yellowish brown (10YR 5/4) fine sandy loam; weak coarse subangular blocky structure parting to weak very fine subangular blocky; very friable; yellowish brown (10YR 4/4) coatings on faces of peds; strongly acid; clear smooth boundary.

C—53 to 60 inches; pale brown (10YR 6/4) fine sandy loam; weak very fine subangular blocky structure; very friable; thin strata less than 1 inch thick of dark yellowish brown (10YR 4/4) loamy fine sand throughout horizon; medium acid.

The thickness of the solum is commonly 40 to 60 inches but ranges from 32 to 60 inches or more. Depth to sand or stratified material ranges from 36 to 60 inches. Depth to free carbonates ranges from 40 inches to 72 inches or more.

The A horizon has value of 2 or 3. It is fine sandy loam or loam. An E horizon is in some pedons. The Bt horizon has hue of 10YR or 7.5YR and value of 4 or 5. It is medium acid or strongly acid. The C horizon has value and chroma of 4 through 6. It is fine sandy loam or sandy loam in the upper part but is loamy sand in the lower part in some pedons. The C horizon is medium acid or strongly acid. In many pedons this horizon has thin strata of loam or silt loam.

The Lamont soil in the Timula-Lamont complex, 40 to 70 percent slopes, is outside the range defined for the Lamont series because it has a thicker dark surface layer and is very steep. These differences, however, do not alter the usefulness and behavior of the soil.

Lilah Series

The Lilah series consists of deep, well drained, very rapidly permeable soils on stream terraces along the Mississippi River. These soils formed in a thin mantle of loamy alluvium and the underlying stratified gravel and sand. Slope ranges from 2 to 6 percent.

Lilah soils are similar to and commonly associated on the landscape with Billett and Dickinson soils. Billett and Dickinson soils have less coarse sand than Lilah soils and have fine gravel throughout. They are on positions similar to those of Lilah soils.

Typical pedon of Lilah sandy loam, 2 to 6 percent slopes; 1,250 feet south and 650 feet west of the northeast corner of sec. 16, T. 104 N., R. 4 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; very friable; about 3 percent pebbles; slightly acid; abrupt smooth boundary.

BA—9 to 12 inches; dark yellowish brown (10YR 4/4) sandy loam; few dark brown (10YR 3/3) masses; weak medium subangular blocky structure; very friable; medium acid; gradual smooth boundary.

Bt1—12 to 19 inches; dark brown (7.5YR 4/4) sandy loam; thin dark brown (7.5YR 3/2) coatings on faces of peds; weak medium subangular blocky structure; very friable; some clay bridging between sand grains; about 3 percent pebbles; medium acid; clear smooth boundary.

2Bt2—19 to 25 inches; dark brown (7.5YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; about 15 percent pebbles;

clay bridging between sand grains; medium acid; clear smooth boundary.
2Bt3—25 to 40 inches; dark brown (7.5YR 4/4) sand; single grain; loose; about 5 percent pebbles; few clay bridgings on sand grains; medium acid; clear smooth boundary.
2C—40 to 60 inches; stratified dark brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4) sand and gravelly sand; single grain; loose; as much as 20 percent pebbles in thin strata; slightly acid.

The thickness of the solum and depth to stratified coarse material range from 30 to 42 inches. Free carbonates are above a depth of 40 inches in some pedons. The solum contains as much as 5 percent coarse fragments, and the C horizon contains from 5 to 25 percent. Coarser fragments are mostly igneous or metamorphic rock.

The Ap horizon has chroma of 2 or 3. It is sandy loam or loam and is slightly acid or medium acid. The B horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It is sandy loam or loam and is slightly acid through strongly acid. The 2C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 through 6. It is medium acid or slightly acid.

Lindstrom Series

The Lindstrom series consists of deep, well drained, moderately permeable soils on concave foot slopes and the upper reaches of drainageways in the uplands. These soils formed in silty loess and colluvium. Slope ranges from 1 to 20 percent.

Lindstrom soils are associated on the landscape with Eitzen, Eyota, and Littleton soils. Eitzen soils are stratified and are in drainageways. Eyota soils are coarse-loamy and are on positions similar to those of Lindstrom soils. Littleton soils are somewhat poorly drained and are on nearly level positions on terraces.

Typical pedon of Lindstrom silt loam, 1 to 6 percent slopes; 2,440 feet north and 1,925 feet east of the southwest corner of sec. 17, T. 104 N., R. 6 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.
A—7 to 27 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; medium very fine subangular blocky structure; very friable; black (10YR 2/1) coatings on faces of peds; many fine pores; neutral; gradual smooth boundary.
BA—27 to 31 inches; brown (10YR 4/3) silt loam; moderate medium subangular blocky structure; very friable; many fine pores; thin light gray (10YR 7/1) silt coatings on faces of peds; neutral; clear smooth boundary.
Bw—31 to 36 inches; yellowish brown (10YR 5/4) silt loam; moderate coarse subangular blocky structure; very friable; dark yellowish brown (10YR 4/4) coatings on faces of peds; neutral; clear smooth boundary.
Bt1—36 to 45 inches; dark yellowish brown (10YR 4/4) silt loam; moderate coarse subangular blocky structure; very friable; dark brown (10YR 4/3) coatings on faces of peds; many dark brown (10YR 3/3) clay films; neutral; clear smooth boundary.
Bt2—45 to 56 inches; dark yellowish brown (10YR 4/4) silt loam; common fine distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/8) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; very friable; common moderately thick dark brown (10YR 3/3) clay films; neutral; clear smooth boundary.
Bt3—56 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common fine prominent yellowish brown (10YR 5/8) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; very friable; common thick very dark grayish brown (10YR 3/2) clay films; slightly acid.

The solum ranges from 50 to 80 inches in thickness. The mollic epipedon ranges from 24 to 48 inches in thickness.

The A horizon has value of 1 or 2 in the upper part. It is typically silt loam but in some pedons is loam in the upper part. The A horizon is medium acid through neutral. The B horizon typically has hue of 10YR in the upper part and hue of 10YR or 2.5Y in the lower part. It has value of 4 or 5 and chroma of 3 or 4. The B horizon is neutral through medium acid.

Lindstrom loam, 12 to 20 percent slopes, is outside the range defined for the Lindstrom series because it has more sand in the solum. This difference, however, does not alter the usefulness or behavior of the soil.

Littleton Series

The Littleton series consists of deep, somewhat poorly drained, moderately permeable soils on broad, plane to slightly concave surfaces on terraces. These soils formed in silty alluvium. Slope ranges from 1 to 3 percent.

Littleton soils are associated on the landscape with Festina and Madelia soils. Festina soils do not have a mollic epipedon, are well drained and moderately well drained, and are on the slightly higher positions. Madelia soils are poorly drained and are on the slightly lower positions.

Typical pedon of Littleton silt loam; 140 feet west and 1,400 feet south of the northeast corner of sec. 12, T. 104 N., R. 7 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.
A—7 to 39 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine and fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.
Bw—39 to 53 inches; brown (10YR 4/3) silty clay loam; common fine distinct light olive brown (2.5Y 5/6) mottles; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; slightly acid; clear smooth boundary.
BC—53 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine prominent light olive brown (2.5Y 5/6) and yellowish brown (10YR 5/8) mottles; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; a few thick black (N 2/0) clay films on faces of peds; friable; slightly acid.

The solum is 40 to 60 inches thick. The mollic epipedon is 24 to 40 inches thick.

The Ap horizon consists of 0 to 15 inches of recently deposited sediment. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is neutral or slightly acid. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It is silt loam or silty clay loam and is slightly acid or medium acid. A C horizon is within a depth of 60 inches in some pedons.

Madelia Series

The Madelia series consists of deep, poorly drained, moderately permeable soils on terraces. These soils formed in silty alluvium from loess or in a thin mantle of loess and the underlying silty alluvium. Slope ranges from 1 to 3 percent.

Madelia soils are associated on the landscape with and are similar to Littleton and Walford soils. Littleton soils are somewhat poorly drained and are on the slightly higher positions. Walford soils do not have a mollic epipedon. They are on positions similar to those of Madelia soils.

Typical pedon of Madelia silt loam; 200 feet south and 1,400 feet west of the northeast corner of sec. 27, T. 104 N., R. 6 W.

Ap—0 to 11 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; few black (10YR 2/1) masses; moderate very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
A—11 to 20 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; few masses of very dark brown (10YR 2/2); moderate very fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
AB—20 to 23 inches; very dark grayish brown (2.5Y 3/2) silt loam, grayish brown (10YR 5/2) dry; few fine prominent yellowish brown (10YR 5/6) mottles; weak thin platy structure parting to moderate very fine subangular blocky; very friable; slightly acid; clear smooth boundary.
Bg—23 to 38 inches; olive gray (5Y 4/2) silt loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; medium acid; clear smooth boundary.
BCg—38 to 46 inches; olive gray (5Y 5/2) silt loam; common fine prominent yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; friable; medium acid; clear smooth boundary.
Cg—46 to 60 inches; light olive gray (5Y 6/2) silt loam; many fine and medium prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; massive; friable; slightly acid.

The thickness of the solum is 40 to 70 inches. Depth to free carbonates ranges from 60 to 90 inches or more. The mollic epipedon commonly is 16 to 24 inches thick but ranges from 10 to 24 inches.

The A or Ap horizon consists of recently deposited sediment in many places. It is as much as 15 inches thick or is absent in some pedons. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is neutral or slightly acid. The Bg horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It typically is silt loam but ranges to silty clay loam and is slightly acid or medium acid. The Cg horizon has value of 5 or 6 and chroma of 1 or 2. It is mildly alkaline or moderately alkaline.

Massbach Series

The Massbach series consists of deep, well drained and moderately well drained soils on narrow ridges in dissected uplands. These soils formed in 30 to 50 inches of loess and the underlying clay residuum weathered from Decorah shale. Permeability is moderate in the loess and slow in the underlying residuum. Slope ranges from 3 to 12 percent.

Massbach soils are similar to Shullsburg soils and are associated on the landscape with Frankville and Nasset soils. Shullsburg soils have a thinner loess mantle than the Massbach soils, and Frankville and Nasset soils are underlain by reddish brown clay residuum weathered from limestone. All of these soils are on positions similar to those of Massbach soils.

Typical pedon of Massbach silt loam, 6 to 12 percent slopes; 1,700 feet west and 1,800 feet north of the southeast corner of sec. 8, T. 101 N., R. 6 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine

subangular blocky structure; friable; slightly acid; clear smooth boundary.
BA—9 to 15 inches; dark brown (10YR 4/3) silt loam; very fine subangular blocky structure; friable; common thick coatings of sand and silt particles on faces of peds; slightly acid; clear smooth boundary.
Bt1—15 to 29 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; few thin discontinuous clay films on faces of peds; few coatings of silt and very fine sand on faces of peds; slightly acid; clear smooth boundary.
Bt2—29 to 37 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate coarse subangular blocky; friable; thin continuous clay films on faces of peds; thin nearly continuous light brownish gray (10YR 6/2) coatings of silt on faces of peds; few black (10YR 2/1) manganese concretions; slightly acid; clear smooth boundary.
2Bt3—37 to 45 inches; grayish brown (2.5Y 5/3) silty clay; many coarse distinct yellowish brown (10YR 5/6) and many medium prominent yellowish brown (10YR 5/8) mottles; moderate medium prismatic structure parting to moderate coarse subangular blocky; firm; few moderately thick very dark brown (10YR 2/2) clay films on faces of peds and in root channels and pores; neutral; clear smooth boundary.
2Cr—45 to 60 inches; pale olive (5Y 6/4) soft shale; few masses of gray (5Y 6/1) and yellowish brown (10YR 5/6); massive; very firm; common very fine shale fragments in lower part; about 15 percent channers of limestone in lower part; strong effervescence; mildly alkaline.

The thickness of the solum, depth to free carbonates, and depth to shale residuum range from 40 to 55 inches. The loess mantle is 30 to 50 inches thick.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is neutral through medium acid. In some pedons an E horizon, 2 to 3 inches thick, is below the Ap horizon. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. Common distinct to prominent low and high chroma mottles are below the upper part of the argillic horizon. The Bt horizon is silt loam in the upper part and silt loam or silty clay loam in the lower part. The Bt horizon is neutral through medium acid. The 2B horizon has value of 5 or 6 and chroma of 3 or 4 in the matrix. The upper part of the horizon contains a few channers, and the lower part contains as much as 30 percent channers. The 2Cr horizon has value of 5 or 6 and chroma of 3 through 5.

Minneiska Series

The Minneiska series consists of deep, moderately well drained soils on flood plains. These soils formed in loamy alluvium and the underlying loamy to sandy sediment. They are subject to occasional flooding. Permeability is moderately rapid. Slope ranges from 0 to 2 percent.

Minneiska soils are associated on the landscape with Kalmarville, Minneiska Variant, and Rawles soils. Kalmarville soils are poorly drained and are typically on the lower positions. Minneiska Variant soils have a sandy mantle and are adjacent to the river channel. Rawles soils are silty and are on positions similar to those of Minneiska soils.

Typical pedon of Minneiska fine sandy loam, occasionally flooded; 900 feet north and 1,800 feet east of the southwest corner of sec. 30, T. 104 N., R. 6 W.

Ap—0 to 11 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; very friable; strong effervescence; mildly alkaline; clear smooth boundary.
C1—11 to 19 inches; very dark brown (10YR 2/2) loam; thin strata of light olive brown (2.5Y 5/3) loamy fine sand; weak very thin to thick platy structure; very friable; strong effervescence; mildly alkaline; clear smooth boundary.
C2—19 to 25 inches; very dark grayish brown (10YR 3/2) loamy fine sand; thin strata of fine sandy loam; weak very fine subangular blocky structure; very friable; strong effervescence; mildly alkaline; clear smooth boundary.
2C—25 to 60 inches; grayish brown (2.5Y 4/2) sand; thin strata of very dark grayish brown (10YR 3/2) and light olive brown (2.5Y 5/3) loamy sand, sandy loam, and loam; very thin to thick platy structure; loose in sand and very friable in finer textured parts; strong effervescence; mildly alkaline.

Typically, this soil does not have coarse fragments, but the lower part of the control section in some pedons has as much as 10 percent coarse fragments less than 5 millimeters in diameter.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is sandy loam, fine sandy loam, very fine sandy loam, loam, or silt loam. The C horizon is stratified in color and texture. The strata have hue of 10YR or 2.5Y. Value is mainly 2 or 3 but ranges to 4 or 5 in thin strata. Chroma is 2 or 3. The strata dominantly are silt loam, loam, fine sandy loam, or very fine sandy loam, but thin strata are loamy fine sand, loamy sand, sand, or fine sand. The 2C horizon is dominantly fine sand, loamy fine sand, loamy sand, or sand but in some pedons has thin strata of sandy loam or silt loam 1 or 2 inches thick.

Minneiska Variant

The Minneiska Variant consists of deep, well drained and moderately well drained soils near stream channels and former channels of the Root River. These soils formed in sandy alluvium and a buried loamy soil within a depth of 40 inches. They are subject to occasional flooding. Permeability is moderately rapid. Slope ranges from 0 to 3 percent.

Minneiska Variant soils are associated on the landscape with Abscota and Minneiska soils. These soils are on positions similar to those of the Minneiska Variant soils. Abscota soils are more than 40 inches deep to loamy material, and Minneiska soils are loamy in the upper part.

Typical pedon of Minneiska Variant loamy fine sand; 2,100 feet west and 950 feet north of the southeast corner of sec. 25, T. 104 N., R. 6 W.

A—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C—9 to 29 inches; very dark grayish brown (10YR 3/2) fine sand; thin strata of dark grayish brown (10YR 4/2) loamy fine sand and very dark grayish brown (10YR 3/2) fine sandy loam and silt loam; weak very thin platy structure; loose; slight effervescence; mildly alkaline; clear smooth boundary.

2Ab—29 to 60 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; very friable; neutral.

The sandy mantle ranges from 20 to 40 inches in thickness. The A horizon has chroma of 2 or 3. It is loamy fine sand or fine sand. The C horizon dominantly has value of 3 and chroma of 2 or 3 but has thin strata that have value of 4 or 5 and chroma of 2 or 3. It is dominantly fine sand or loamy fine sand and has thin strata of fine sandy loam, loam, or silt loam. The C horizon is neutral or mildly alkaline. The 2Ab horizon has value of 2 or 3 and chroma of 1 or 2. It is typically silt loam or loam but ranges to fine sandy loam or sandy loam in the lower part of some pedons. A sand or loamy sand 2C horizon is below a depth of 40 inches in some pedons.

Moundprairie Series

The Moundprairie series consists of deep, poorly drained and very poorly drained, moderately permeable soils on flood plains. These soils formed in recent calcareous silty alluvium. Slope is 0 to 1 percent.

Moundprairie soils are associated on the landscape with Colo and Rawles soils and are similar to Colo soils. Colo soils do not have a thick mantle of calcareous sediment. They are on positions similar to those of Moundprairie soils. Rawles soils are moderately well drained and commonly are nearer to the stream channel.

Typical pedon of Moundprairie silty clay loam, occasionally flooded; 1,300 feet east and 100 feet north of the southwest corner of sec. 28, T. 104 N., R. 5 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common fine distinct dark brown (7.5YR 4/3) mottles; weak very fine granular structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

Cg—10 to 40 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; thin strata of dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; laminated; very friable; strong effervescence; mildly alkaline; clear smooth boundary.

Ab1—40 to 56 inches; black (N 2/0) silty clay loam, very dark gray (10YR 5/1) dry; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

Ab2—56 to 60 inches; very dark gray (N 3/0) silty clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; neutral.

The thickness of the silty recent alluvial sediment and depth to the buried soil are 20 to 60 inches. The Ap horizon does not have mottles in some pedons. It typically is silt loam or silty clay loam but ranges to loam in some pedons. The Ap horizon is mildly alkaline or moderately alkaline. The Cg horizon typically has hue of 10YR but ranges to hue of 2.5Y. Dominantly, it has value of 3 and chroma of 1 but has strata with value of 4 or 5 and chroma of 1 or 2. The Cg horizon is silt loam or silty clay loam, but the lighter colored strata typically have less clay, more sand, or both of these than the darker colored strata. It is mildly alkaline or moderately alkaline. The Ab horizon is black (N 2/0) or very dark gray (N 3/0) or has hue of 10YR through 5Y, value of 2 or 3, and chroma of 1. It typically is silt loam or silty clay loam, but it is loam or fine sandy loam in some or all parts in some pedons.

Mt. Carroll Series

The Mt. Carroll series consists of deep, well drained, moderately permeable soils on summits and upper side slopes of broad ridges in dissected uplands. These soils formed in loess. Slope ranges from 3 to 20 percent.

Mt. Carroll soils are similar to and are associated on the landscape with Port Byron and Seaton soils. Port Byron soils have a thicker dark surface horizon, and Seaton soils have a lighter colored surface horizon. These soils are on positions similar to those of the Mt. Carroll soils.

Typical pedon of Mt. Carroll silt loam, 6 to 12 percent slopes; 2,100 feet east and 1,700 feet south of the northwest corner of sec. 22, T. 102 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure parting to moderate fine and very fine subangular blocky; very friable; slightly acid; abrupt smooth boundary.

BA—8 to 14 inches; brown (10YR 4/3) silt loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; few thin coatings of dark grayish brown (10YR 4/2) on faces of peds; strongly acid; clear smooth boundary.

Bt1—14 to 20 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure parting to moderate fine and very fine subangular blocky; friable; common moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—20 to 35 inches; yellowish brown (10YR 5/4) silt loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear smooth boundary.

BC—35 to 52 inches; brown (10YR 5/3) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure parting to weak and moderate medium and fine subangular blocky; friable; yellowish brown (10YR 5/4) coatings on faces of peds; few thin very dark grayish brown (10YR 3/2) clay films along old root channels and pores; strongly acid; clear smooth boundary.

C—52 to 60 inches; brown (10YR 5/3) silt loam; many fine and medium distinct strong brown (7.5YR 5/6) and yellowish red (5YR 5/6) mottles; weak coarse subangular blocky structure; friable; few thin very dark grayish brown (10YR 3/2) clay films in old root channels and pores; medium acid.

The solum is 36 to 60 inches thick. The A horizon has value of 2 or 3. An E horizon is present in areas that have not been cultivated. The A horizon is neutral through medium acid. The Bt horizon has value of 4 or 5 and chroma of 3 through 5. It is medium acid or strongly acid. The BC or C horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 3 through 6. This horizon has mottles of high or low chroma in some pedons. It is medium acid through neutral.

Muscatine Series

The Muscatine series consists of deep, somewhat poorly drained, moderately permeable soils on slightly concave head slopes in uplands. These soils formed in loess. Slope ranges from 1 to 3 percent.

Muscatine soils are associated on the landscape with Mt. Carroll and Port Byron soils. Mt. Carroll soils are well drained, and Port Byron soils are well drained and moderately well drained. These soils are upslope from Muscatine soils.

Typical pedon of Muscatine silt loam; 1,160 feet south and 2,470 feet east of the northwest corner of sec. 23, T. 102 N., R. 6 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; weak very fine subangular blocky structure; friable; medium acid; clear smooth boundary.

AB—9 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to moderate very fine subangular blocky; friable; nearly continuous light gray (10YR 7/1) silt coatings on faces of peds; medium acid; clear smooth boundary.

Bt1—15 to 28 inches; dark brown (10YR 4/3) silty clay loam; common fine distinct grayish brown (2.5Y 5/2) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common thin black (10YR 2/1) clay films in root channels and pores; thin nearly continuous light gray (10YR 7/1) uncoated silt grains on faces of peds; strongly acid; gradual smooth boundary.

Bt2—28 to 42 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine and medium prominent dark yellowish brown (10YR 4/4) mottles; moderate coarse prismatic structure parting to moderate very coarse subangular blocky; friable; common moderately thick very dark gray (10YR 3/1) clay films on faces of peds; common thick black (10YR 2/1) clay films in root channels and pores; strongly acid; clear smooth boundary.

BC—42 to 56 inches; yellowish brown (10YR 5/4) silt loam; many fine and medium prominent light brownish gray (2.5Y 6/2) mottles; weak very coarse prismatic structure parting to weak very coarse subangular blocky; friable; common thin to moderately thick very dark gray (10YR 3/1) and black (10YR 2/1) clay films on faces of peds; common moderately thick black (10YR 2/1) clay films in root channels and pores; strongly acid; gradual smooth boundary.

C—56 to 60 inches; yellowish brown (10YR 5/4) silt loam; many fine prominent light brownish gray (2.5Y 6/2) mottles; massive; friable; few moderately thick black (10YR 2/1) clay films in fine pores; strongly acid.

Thickness of the solum ranges from 45 to 60 inches. Thickness of the mollic epipedon is 10 to 24 inches.

The Ap horizon has chroma of 1 or 2. It is neutral through medium acid. The Bt horizon has hue of 10YR and chroma of 2 or 3 or hue of 2.5Y and chroma of 3 or 4. The upper part of this horizon in some pedons does not have low chroma mottles. The Bt horizon is medium acid or strongly acid. The BC and C horizons have hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 through 5. They are medium acid or strongly acid.

Nasset Series

The Nasset series consists of deep, well drained soils on narrow ridges in loess covered uplands. These soils formed in a silty mantle and in an underlying clayey and clayey-skeletal residuum weathered from limestone. Permeability is moderate in the silty mantle and slow in the clayey residuum. Slope ranges from 3 to 12 percent.

Nasset soils in Houston County are outside the range defined for the Nasset series because they have a thicker clayey subsoil and hard bedrock is at a depth of more than 60 inches. These differences, however, do not alter the usefulness or behavior of the soils.

Nasset soils are similar to Mt. Carroll soils and are associated on the landscape with Mt. Carroll, Frankville, and Massbach soils. These soils are on positions similar to those of Nasset soils. Mt. Carroll soils have a thicker loess mantle, Frankville soils have a thinner loess mantle, and Massbach soils are underlain by shale.

Typical pedon of Nasset silt loam, 3 to 6 percent slopes; 1,520 feet east of the southwest corner of sec. 15, T. 101 N., R. 7 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; neutral; abrupt smooth boundary.

BA—8 to 12 inches; brown (10YR 4/3) silt loam; moderate to fine subangular blocky structure; very friable; few dark grayish brown (10YR 4/2) coatings on faces of peds; neutral; clear smooth boundary.

Bt1—12 to 25 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure parting to moderate fine and very fine subangular blocky; friable; few thin dark brown (10YR 3/3) clay films; slightly acid; clear smooth boundary.

Bt2—25 to 39 inches; yellowish brown (10YR 5/4) silt loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; few thin dark brown (10YR 3/3) clay films; dark yellowish brown (10YR 4/4) coatings on faces of peds; medium acid; clear smooth boundary.

Bt3—39 to 45 inches; yellowish brown (10YR 5/4) silt loam; weak coarse subangular blocky structure parting to weak medium subangular blocky; friable; few thin dark brown (10YR 3/3) clay films; dark yellowish brown (10YR 4/4) coatings on faces of peds; medium acid; clear smooth boundary.

2Bt4—45 to 54 inches; reddish brown (5YR 4/4) silty clay; strong coarse prismatic structure parting to strong medium and fine angular blocky; very firm; about 5 percent limestone channers and flagstones; neutral; gradual smooth boundary.

2Bt5—54 to 60 inches; reddish brown (5YR 4/4) very flaggy silty clay; strong very fine subangular blocky structure; firm; about 90 percent limestone fragments; clay films surrounding rock fragments; strong effervescence; mildly alkaline.

Thickness of the loess mantle ranges from 45 to 80 inches or more. Depth to the clayey-skeletal material is 40 to 55 inches. Depth to hard bedrock is 60 to 100 inches or more. The upper part of the 2B horizon typically has less than 10 percent coarse fragments but has as much as 35 percent in some pedons. The coarse fragments consist of chert, channers, and flagstones. The lower part of the 2B horizon has 75 to 90 percent coarse limestone fragments, mostly flagstones.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. In pedons that are not cultivated, an A horizon 3 to 8 inches thick and an E horizon 2 to 4 inches thick are present. The A horizon is neutral or slightly acid. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is dominantly silt loam, but in parts of some pedons it is silty clay loam. The Bt horizon is medium acid or strongly acid. The 2Bt horizon ranges from 4 to 24 inches in thickness but commonly is 6 to 15 inches thick. It has hue of 10YR or 5YR, value of 4 through 6, and chroma of 4 through 8. The 2Bt horizon is typically silty clay, clay, flaggy silty clay, or flaggy clay. It is neutral or mildly alkaline in the fine earth fraction.

Newalbin Series

The Newalbin series consists of deep, poorly drained and very poorly drained soils on flood plains. These soils formed in recent silty alluvial sediment and the underlying buried loamy soil. Permeability is moderate. Slope ranges from 0 to 4 percent.

Newalbin soils are associated on the landscape with Arenzville and Comfrey soils. Arenzville soils are moderately well drained and well drained. Typically, they are on more elevated positions than Newalbin soils. Comfrey soils do not have a silty mantle of recent sediment. They are on positions similar to those of Newalbin soils.

Typical pedon of Newalbin silt loam; 500 feet north and 420 feet east of the southwest corner of sec. 24, T. 103 N., R. 5 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine platy structure; very friable; many very fine roots; neutral; clear smooth boundary.

Cg—3 to 57 inches; dark gray (10YR 4/1) silt loam; very thin strata of grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) very fine sand; common fine prominent strong brown (7.5YR 5/8) and dark brown (7.5YR 3/2) mottles; weak very fine laminations; very friable; common fine roots; common very fine tubular pores; neutral; clear smooth boundary.

2Ab—57 to 60 inches; black (10YR 2/1) fine sandy loam; weak fine subangular blocky structure; very friable; common very fine and fine pores; neutral.

The thickness of the recent silty alluvial sediment over the buried soil is 20 to 70 inches.

The Cg horizon is stratified in color and texture. It has hue of 10YR or 2.5Y, value of 3 through 5, chroma of 1 or 2. It has distinct or prominent mottles. The Cg horizon is dominantly silt loam, but it has strata of very fine sandy loam, fine sandy loam, loamy very fine sand, or loamy fine sand. It is slightly acid or neutral. The buried soil is silt loam, silty clay loam, loam, sandy loam, or fine sandy loam. It is slightly acid through mildly alkaline.

Newhouse Series

The Newhouse series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess and the underlying stratified loamy erosional sediment from sandstone, shale, or dolomite. Slope ranges from 6 to 20 percent.

Newhouse soils in Houston County are mapped only in complex with Valton soils. Newhouse soils are associated on the landscape with Mt. Carroll, Nodine, Port Byron, Rollingstone, and Valton soils. Mt. Carroll and Port Byron soils have a thicker mantle of loess than Newhouse soils and typically are upslope. Nodine and Rollingstone soils have a thinner mantle of loess and typically are downslope. Valton soils have a subsoil that formed in clay erosional sediment and are on positions similar to those of Newhouse soils.

Typical pedon of Newhouse silt loam, in an area of Newhouse-Valton silt loams, 6 to 12 percent slopes; 2,450 feet west and 425 feet north of the southeast corner of sec. 10, T. 101 N., R. 6 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; few thin very dark brown (10YR 2/2) coatings on faces of peds; few mixings of dark yellowish brown (10YR 4/4); neutral; clear smooth boundary.

BA—9 to 13 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine subangular blocky structure; friable; few thin dark brown (10YR 4/3) coatings on faces of peds; continuous thick pale brown (10YR 6/3) silt and sand grain coatings on faces of peds; neutral; clear smooth boundary.

Bt1—13 to 23 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; friable; dark brown (10YR 4/3) coatings on faces of peds; few thin pale brown (10YR 6/3) silt and sand grain coatings on faces of peds; thin discontinuous clay films on faces of peds; neutral; clear smooth boundary.

Bt2—23 to 25 inches; dark brown (7.5YR 4/4) silt loam; moderate medium subangular blocky structure; friable; few thin grayish brown (10YR 5/2) silt and sand grain coatings on faces of peds; thin discontinuous clay films on faces of peds; few fine manganese concretions; medium acid; abrupt wavy boundary.

2Bt3—25 to 60 inches; strong brown (7.5YR 4/6) and yellowish red (5YR 4/6) stratified fine sandy loam, sandy loam, and sandy clay loam, few masses of loamy sand and sand, and thin strata of olive (5YR 5/6) clay; weak coarse prismatic structure parting to weak medium subangular blocky; friable; few moderately thick clay films on faces of peds; few manganese concretions; few thin grayish brown (10YR 5/2) silt grains on faces of peds; about 5 percent chert fragments; strongly acid.

Thickness of the solum, depth to free carbonates, and depth to bedrock typically range from 60 to 100 inches but are more than 100 inches in some pedons. Thickness of the loess ranges from 15 to 30 inches.

The Ap horizon has value and chroma of 2 or 3. In uncultivated pedons the A horizon has value of 2 or 3 and chroma of 1 or 2. An E horizon is present in some pedons. The A horizon is neutral through medium acid. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam and is slightly acid through strongly acid. The 2B horizon is stratified in color and texture. Hue dominantly is 7.5YR but in some pedons is 2.5Y or 10YR. The 2B horizon has value and chroma of 4 through 7. Strata, including the thin clayey and sandy strata or masses, are dominantly sandy clay loam, clay loam, sandy loam, and fine sandy loam. The content of coarse fragments is 5 to 35 percent. The fragments are mostly chert, sandstone, and dolomite. The 2B horizon is medium acid or strongly acid.

Nodine Series

The Nodine series consists of deep, well drained, moderately permeable soils on narrow ridges in dissected uplands. These soils formed in a thin mantle of loess and in the underlying stratified loamy erosional sediment overlying sandstone or dolomite. Slope ranges from 4 to 20 percent.

Nodine soils in Houston County are mapped only in complex with Rollingstone soils. Nodine soils are associated on the landscape with Blackhammer,

Lamoille, and Rollingstone soils. Blackhammer soils have a thicker loess mantle than Nodine soils. Lamoille soils are on steeper slopes and have loamy-skeletal material in the lower part of the subsoil. Rollingstone and Blackhammer soils are on positions similar to those of Nodine soils. Rollingstone soils have a clay subsoil.

Typical pedon of Nodine silt loam, in an area of Nodine-Rollingstone silt loams, 4 to 12 percent slopes, eroded; 1,475 feet west and 450 feet north of the southeast corner of sec. 3, T. 103 N., R. 4 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; massive; very friable; neutral; clear smooth boundary.
BA—7 to 10 inches; dark yellowish brown (10YR 4/4) silt loam; a few masses and coatings on the faces of peds of dark grayish brown (10YR 4/2); weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
2Bt—10 to 60 inches; stratified yellowish brown (10YR 5/4, 10YR 5/6), strong brown (7.5YR 4/6, 7.5YR 5/6), reddish yellow (7.5YR 6/6), and red (2.5YR 4/6) clay, clay loam, sandy clay loam, sandy loam, and loamy sand; weak and moderate medium and coarse subangular blocky structure; very friable through firm; about 10 percent coarse fragments; few thin black (10YR 2/1) coatings on faces of peds; few thin dark brown (10YR 3/3) clay films on faces of peds, mostly in loamy and clayey parts; strongly acid.

Thickness of the solum, depth to free carbonates, and depth to bedrock typically are 60 to 90 inches but range to as much as 120 inches or more. The loess mantle is 5 to 15 inches thick. The content of sandstone or chert fragments ranges from 0 to 5 percent in the loess mantle and from 5 to 35 percent in the underlying horizons.

The Ap horizon has value of 3 or 4 moist and 6 or more dry and chroma of 2 or 3. In pedons that are not cultivated, an A horizon ranging from 2 to 4 inches in thickness and an E horizon ranging from 3 to 7 inches are present. The A horizon is silt loam or silt and is medium acid through neutral. The B horizon in the loess mantle has chroma of 3 or 4. It is slightly acid through strongly acid. The 2B horizon is stratified in color and texture. It dominantly has hue of 7.5YR but ranges from 2.5YR through 10YR and has value and chroma of 4 through 6. It is dominantly stratified sandy clay loam, clay loam, and sandy loam and less commonly loamy sand, sand, and clay. The 2B horizon is medium acid or strongly acid.

Norden Series

The Norden series consists of moderately deep, well drained, moderately permeable soils on summits and side slopes of narrow ridges. The ridges extend into valleys from very steep hills on higher elevations. These soils formed in residuum or erosional sediment weathered from Franconia sandstone. Slope ranges from 15 to 45 percent.

Norden soils are associated on the landscape with Council, Eleva, La Farge, and Seaton soils. Council and Seaton soils do not have bedrock within a depth of 60 inches and are on foot slopes. Eleva soils contain less clay than Norden soils and formed in sandy residuum weathered from sandstone of the Jordan and Dresbach Formations. Eleva soils are on positions similar to those of Norden soils. La Farge soils have a thicker mantle of loess and are typically on more gentle slopes.

Typical pedon of Norden silt loam, 15 to 30 percent slopes, eroded; 2,225 feet south and 1,350 feet east of the northwest corner of sec. 7, T. 104 N., R. 6 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; few masses of dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2); slightly acid; clear smooth boundary.
Bt1—5 to 12 inches; dark yellowish brown (10YR 4/4) loam; moderate fine subangular blocky structure; friable; thin discontinuous clay films on faces of peds; about 2 percent channers of sandstone; slightly acid; clear smooth boundary.
Bt2—12 to 17 inches; olive brown (2.5Y 4/4) loam; moderate medium subangular blocky structure; friable; few thin dark brown (10YR 3/3) clay films on faces of peds; about 5 percent greenish gray channers of sandstone; slightly acid; clear smooth boundary.
Bt3—17 to 23 inches; olive brown (2.5Y 4/4) loam; weak coarse subangular blocky structure; friable; about 15 percent greenish gray (5GY 6/1) channers of sandstone; few thin dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear smooth boundary.
BC—23 to 30 inches; olive brown (2.5Y 4/4) and olive (5Y 4/4) loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; about 15 percent channers of sandstone; neutral; clear smooth boundary.
Cr1—30 to 47 inches; olive (5Y 5/4) weathered glauconitic sandstone crushing to sandy loam; weak medium platy structure; very friable; about 15 percent channers of greenish gray (5GY 6/1) sandstone; neutral; clear smooth boundary.
Cr2—47 to 60 inches; olive (5Y 5/4) sandstone.

The thickness of the solum is typically 20 to 35 inches but ranges from 20 to 40 inches. Depth to weathered glauconitic sandstone is 20 to 40 inches. The silt loam mantle ranges from 0 to 20 inches in thickness. The B horizon formed in residuum or erosional sediment and contains as much as 20 percent sandstone fragments.

The Cr horizon contains as much as 85 percent soft sandstone fragments in some pedons.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. In pedons that are not cultivated, an A horizon 2 to 5 inches thick and an E horizon 3 to 6 inches thick are present. The Ap horizon is fine sandy loam, loam, or silt loam. It is slightly acid through strongly acid. An AB horizon is present in some pedons. The Bt horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 3 through 5. It is loam, sandy clay loam, or clay loam and is neutral through strongly acid. The Cr horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 3 through 6. The fine earth fraction in the Cr horizon is fine sandy loam, loam, sandy clay loam, or clay loam. It is medium acid to mildly alkaline.

Palms Series

The Palms series consists of deep, very poorly drained, moderately permeable organic soils. These soils are on nearly level plane surfaces on low terraces and in sloping areas just above narrow flood plains. Slope ranges from 2 to 8 percent.

Palms soils in Houston County are mapped only in complex with Newalbin soils. Palms soils are similar to Boots soils. Boots soils formed in less decomposed organic material than Palms soils and are deeper over mineral soil.

Typical pedon of Palms muck, in an area of Newalbin-Palms complex, 2 to 8 percent slopes; 575 feet north and 1,425 feet east of the southwest corner of sec. 2, T. 104 N., R. 6 W.

Oa1—0 to 10 inches; black (10YR 2/1) sapric material; about 25 percent herbaceous fiber, less than 10 percent rubbed; massive; slightly sticky; about 35 percent mineral material; neutral; clear smooth boundary.

Oa2—10 to 35 inches; very dark brown (10YR 2/2) and black (10YR 2/1) sapric material; about 30 percent herbaceous fiber, about 10 percent rubbed; massive; about 25 percent mineral material; neutral; clear smooth boundary.

2A—35 to 60 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; massive; friable; about 20 percent organic matter; neutral.

The depth to the loamy 2A horizon is 16 to 51 inches. The surface tier has chroma of 0 or 1. It typically is slightly acid or neutral, but in some pedons it is mildly alkaline. The subsurface tier has hue of 10YR or 7.5YR and chroma of 0 through 2. The organic material is dominantly sapric, but thin strata of hemic material are in some pedons. The organic matter typically is neutral or slightly acid, but in some pedons it is mildly alkaline.

The 2A horizon has value of 2 or 3 and chroma of 0 or 1. It is neutral or mildly alkaline. A 2Cg horizon is present in some pedons.

Plainfield Series

The Plainfield series consists of deep, excessively drained, rapidly permeable soils on terraces and foot slopes along river valleys. These soils formed in deep sand. Slope ranges from 0 to 50 percent.

Plainfield soils are associated on the landscape with Billett, Dickinson, and Sparta soils. Billett and Dickinson soils have a loamy mantle. Sparta soils have a mollic epipedon. All of these soils are on positions similar to those of Plainfield soils.

Typical pedon of Plainfield sand, 6 to 12 percent slopes; 850 feet south and 2,300 feet east of the northwest corner of sec. 35, T. 104 N., R. 5 W.

Ap—0 to 4 inches; very dark grayish brown (10YR 3/2) sand, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; slightly acid; clear smooth boundary.

BA—4 to 12 inches; brown (10YR 4/3) sand; single grain; loose; slightly acid; gradual smooth boundary.

Bw—12 to 28 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; slightly acid; gradual smooth boundary.

C—28 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slightly acid.

The solum ranges from 18 to 34 inches in thickness. The content of coarse fragments ranges from 0 to 15 percent, by volume, throughout the soil.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. It is loamy sand, loamy fine sand, sand, or fine sand and is neutral through strongly acid. The B horizon has value of 4 or 5 and chroma of 4 through 6. It is slightly acid through very strongly acid. The C horizon has value of 5 or 6 and chroma of 4 or more. It is slightly acid through strongly acid.

In Houston County, map units 1856D and 1856E are outside the range defined for the Plainfield series. Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes, has slightly thicker, dark colored surface and subsurface layers. Plainfield loamy fine sand, loamy substratum, 25 to 50 percent slopes, has layers of sandy loam and loam in the underlying material. These differences, however, do not alter the usefulness or behavior of these soils.

Port Byron Series

The Port Byron series consists of deep, well drained and moderately well drained, moderately permeable soils on summits and ridgetops in dissected uplands. These soils formed in deep loess. Slope ranges from 1 to 12 percent.

Port Byron soils are associated on the landscape with Mt. Carroll, Newhouse, and Valton soils. Mt. Carroll soils do not have a mollic epipedon and are on positions

similar to those of Port Byron soils. Newhouse and Valton soils typically are downslope. Newhouse soils have a thinner mantle of loess, and in Valton soils the 2B horizons formed in clayey and loamy erosional sediment.

Typical pedon of Port Byron silt loam, 3 to 6 percent slopes; 2,050 feet north and 1,900 feet east of the southwest corner of sec. 34, T. 102 N., R. 7 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; few fine roots; neutral; clear smooth boundary.

AB—9 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.

BA—13 to 18 inches; dark brown (10YR 4/3) silt loam; thin very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate very fine subangular blocky structure; very friable; few fine roots; slightly acid; clear smooth boundary.

Bw1—18 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine subangular blocky structure; friable; thin coatings of dark grayish brown (10YR 4/2) on faces of peds; few fine roots; slightly acid; clear smooth boundary.

Bw2—28 to 39 inches; yellowish brown (10YR 5/4) silt loam; weak coarse subangular blocky structure parting to moderate fine and medium subangular blocky; friable; thin dark brown (10YR 4/3) coatings on faces of peds; few fine roots; medium acid; clear smooth boundary.

Bt—39 to 49 inches; light olive brown (2.5Y 5/4) silt loam; many fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate coarse subangular blocky; friable; few very fine roots; few thin and moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; dark brown (10YR 4/3) coatings on faces of peds; medium acid; clear smooth boundary.

BC—49 to 60 inches; light olive brown (2.5Y 5/4) silt loam; many fine prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; few thick black (10YR 2/1) and very dark gray (10YR 3/1) clay films in root channels and pores; medium acid.

The thickness of the solum ranges from 36 to 60 inches or more. The mollic epipedon typically is 10 to 16 inches thick but ranges to 24 inches.

The A horizon has value of 2 and chroma of 1 or 2. It is neutral through medium acid. The B horizon has value of 4 or 5 and chroma of 3 through 5. In many pedons it has high and low chroma mottles below a depth of 30 inches. The B horizon is slightly acid or medium acid. The BC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is neutral through medium acid.

Rawles Series

The Rawles series consists of deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in recent calcareous silty alluvium. Slope is 0 to 1 percent.

Rawles soils are associated on the landscape with Minneiska and Moundprairie soils. Minneiska soils are coarse-loamy and commonly are adjacent to the stream channel or former stream channels. Moundprairie soils are poorly drained and are in channels, in depressions, or on the slightly lower positions.

Typical pedon of Rawles silt loam, occasionally flooded; 1,090 feet north and 1,700 feet east of the southwest corner of sec. 28, T. 104 N., R. 5 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; massive; very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

C—9 to 41 inches; finely stratified very dark grayish brown (10YR 3/2), black (10YR 2/1), brown (10YR 5/3), and very dark gray (10YR 3/1) silt loam; laminated; very friable; few snail shells in parts; strong effervescence; mildly alkaline; abrupt smooth boundary.

Ab—41 to 49 inches; very dark gray (10YR 3/1) silty clay loam; moderate very fine subangular blocky structure; friable; continuous black (10YR 2/1) coatings on faces of peds; few limy masses; slight effervescence; mildly alkaline; abrupt smooth boundary.

C'—49 to 60 inches; stratified black (10YR 2/1) and very dark gray (10YR 3/1) silt loam; laminated; very friable; few snail shells; strong effervescence; mildly alkaline.

The thickness of the silty sediment ranges from 40 to 80 inches or more. The Ap horizon has chroma of 1 or 2. It is silt loam or loam and is mildly alkaline or moderately alkaline. The C horizon above the buried soil has hue of 10YR or 2.5Y, value of 2 through 5, and chroma of 1 through 3. It typically is silt loam but has thin, finer or coarser textured layers in some pedons. The C horizon is mildly alkaline or moderately alkaline. The Ab horizon has value of 2 or 3 and chroma of 1 or 2. It typically is silt loam or silty clay loam but ranges to fine sandy loam or loam. The Ab horizon is mildly alkaline or moderately alkaline. A Bb horizon as thick as 20 inches is in some pedons. A sandy 2C horizon begins at a depth as shallow as 40 inches in some pedons.

Richwood Series

The Richwood series consists of deep, well drained, moderately permeable soils on stream terraces along the Root River. These soils formed in a mantle of silty alluvium and the underlying sandy alluvium. Slope ranges from 0 to 2 percent.

Richwood soils are similar to and associated on the landscape with Bertrand and Festina soils. Bertrand and Festina soils do not have a mollic epipedon. They are on positions similar to those of Richwood soils.

Typical pedon of Richwood silt loam; 380 feet west and 1,470 feet south of the northeast corner of sec. 27, T. 104 N., R. 6 W.

Ap—0 to 11 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—11 to 14 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; thin light gray (10YR 7/1) coatings of very fine sand on faces of peds; neutral; clear smooth boundary.

BA—14 to 21 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; thin light gray (10YR 7/1) coatings of very fine sand on faces of peds; neutral; clear smooth boundary.

Bt1—21 to 30 inches; dark yellowish brown (10YR 4/4) silt loam; moderate coarse subangular blocky structure; friable; few moderately thick dark brown (10YR 3/3) clay films on faces of peds; neutral; clear smooth boundary.

Bt2—30 to 42 inches; yellowish brown (10YR 5/4) silt loam; moderate coarse subangular blocky structure; few fine distinct grayish brown (2.5Y 5/2) mottles; weak coarse subangular blocky structure; friable; few moderately thick dark brown (10YR 3/3) clay films; thin dark yellowish brown (10YR 4/4) coatings on faces of peds; slightly acid; clear smooth boundary.

2Bt3—42 to 45 inches; dark yellowish brown (10YR 4/4) sandy loam; weak coarse subangular blocky structure; very friable; few moderately thick dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear smooth boundary.

2C—45 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few thin strata of dark yellowish brown (10YR 4/4) loamy sand; slightly acid.

The thickness of the solum is 40 to 65 inches. The thickness of the mollic epipedon typically is 12 to 16 inches but ranges to 20 inches in some pedons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is neutral through medium acid. The Bt horizon has value of 4 or 5. It is neutral through medium acid. The 2B horizon has hue of 10YR or 7.5YR, value of 3 through 5, and chroma of 3 or 4. It is sandy loam or stratified silt loam, loam, sandy loam, and loamy fine sand and is neutral through medium acid. The 2C horizon has value of 4 through 8 and chroma of 2 through 6. It is fine sand or sand and is slightly acid or neutral.

Rollingstone Series

The Rollingstone series consists of deep, well drained soils on ridges in dissected uplands. These soils formed in a thin mantle of loess and clayey erosional sediment or residuum from dolomite. Permeability is moderate in the loess and slow in the material below the loess. Slope ranges from 4 to 20 percent.

Rollingstone soils in Houston County are mapped only in complex with Nodine soils. Rollingstone soils are associated on the landscape with Blackhammer, Lamoille, Nodine, Seaton, and Southridge soils. Blackhammer soils have a thicker mantle of loess than the Rollingstone soils and have a 2B horizon formed in loamy erosional sediment. They typically are upslope. Lamoille soils are downslope and have a loamy-skeletal horizon within a depth of 40 inches. Nodine soils have a loamy subsoil and are on positions similar to those of Rollingstone soils. Seaton soils formed in thick loess and are typically upslope. Southridge soils have a thicker mantle of loess and are on positions similar to those of Rollingstone soils.

Typical pedon of Rollingstone silt loam, in an area of Nodine-Rollingstone silt loams, 12 to 20 percent slopes, eroded; 2,000 feet east and 1,200 feet north of the southwest corner of sec. 7, T. 104 N., R. 4 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

BA—6 to 13 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine subangular blocky structure parting to moderate very fine subangular blocky; friable; medium acid; clear smooth boundary.

2Bt1—13 to 25 inches; red (2.5YR 4/6) cherty clay; strong medium angular blocky structure parting to strong fine angular blocky; very firm; common moderately thick reddish brown (5YR 4/4) clay films on faces of peds and in pores; about 25 percent angular chert fragments; strongly acid; gradual smooth boundary.

2Bt2—25 to 40 inches; red (2.5YR 4/6) cherty clay; strong coarse prismatic structure parting to strong coarse and medium angular blocky; very firm; continuous thick reddish brown (5YR 4/4) clay films on faces of peds and in pores; about 30 percent angular chert fragments; strongly acid; gradual smooth boundary.

2Bt3—40 to 60 inches; red (2.5YR 4/6) cherty clay; strong very coarse prismatic structure parting to strong coarse angular blocky; very firm; continuous thick reddish brown (5YR 4/4) clay films on faces of peds and in pores; about 25 percent angular chert fragments; strongly acid.

The thickness of the solum, depth to free carbonates, and depth to bedrock range from 60 to 100 inches or more. Thickness of the loess ranges from 5 to 15 inches. Content of chert and coarse fragments is less than 5 percent in the loess and 10 to 35 percent in the clayey subsoil.

The A horizon has value of 3 or 4 and chroma of 2 or 3. In pedons that have not been cultivated, an A horizon ranging from 1 to 4 inches in thickness and an E horizon ranging from 3 to 7 inches are present. The A horizon is neutral through medium acid. The B horizon has chroma of 3 or 4. It is slightly acid through strongly acid. The 2B horizon typically has hue of 2.5YR or 5YR but ranges through hue of 7.5YR. It has value and chroma of 4 through 6.

Root Series

The Root series consists of deep, poorly drained and very poorly drained soils on flood plains. These soils formed in alluvium that is silty in the upper part and loamy-skeletal in the lower part. They are subject to frequent flooding. Permeability is moderate in the silty upper part and very rapid in the loamy lower part. Slope ranges from 1 to 4 percent.

Root soils in Houston County are outside the range defined for the Root series because they have a slightly thinner loamy mantle overlying the loamy-skeletal alluvium. This difference, however, does not alter the usefulness or behavior of the soils.

Root soils are associated on the landscape with Beavercreek soils. Beavercreek soils are well drained or moderately well drained and are on the slightly higher positions.

Typical pedon of Root silt loam; 1,300 feet east and 1,580 feet south of the northwest corner of sec. 22, T. 102 N., R. 5 W.

A—0 to 12 inches; stratified dark gray (10YR 4/1), gray (10YR 5/1), and grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; massive; very friable; about 10 percent cobblestones and pebbles; thin strata of sand; slight effervescence; mildly alkaline; clear smooth boundary.

2C1—12 to 25 inches; dark gray (10YR 4/1) cobbly sandy loam; massive; friable; about 40 percent cobblestones and pebbles; slight effervescence; mildly alkaline; clear smooth boundary.

2C2—25 to 60 inches; dark gray (10YR 4/1) and gray (10YR 5/1) very cobbly sandy loam and gravelly loamy sand; massive; friable; about 50 percent pebbles and cobblestones; slight effervescence; mildly alkaline.

The loamy upper mantle is 0 to 20 inches thick. The A and C horizons have as much as 35 percent coarse fragments and the 2C horizon 35 to 70 percent coarse fragments. The coarse fragments are cobbles and pebbles of dolomite.

The A horizon is sandy loam, loam, or silt loam. It is neutral or mildly alkaline. The 2C horizon has hue of 10YR or 2.5Y and value of 4 or 5. The fine earth fraction in this horizon typically is loam or sandy loam but is loamy sand below the control section in some pedons. It is neutral or mildly alkaline.

Seaton Series

The Seaton series consists of deep, well drained, moderately permeable soils on ridges and foot slopes in dissected uplands. These soils formed in deep loess. Slope ranges from 1 to 45 percent.

Seaton soils are associated on the landscape with Blackhammer, Mt. Carroll, and Southridge soils. Blackhammer and Southridge soils formed in a thinner mantle of loess than Seaton soils and typically are downslope from Seaton soils. The subsoil of Blackhammer soils formed in loamy erosional sediment, and the subsoil of Southridge soils formed in clayey erosional sediment. Mt. Carroll soils have a darker colored surface horizon and are on positions similar to those of Seaton soils.

Typical pedon of Seaton silt loam, 3 to 6 percent slopes; 1,580 feet south and 2,225 feet west of the northeast corner of sec. 18, T. 101 N., R. 5 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine subangular blocky structure; very friable; slightly acid; abrupt smooth boundary.

Bt1—9 to 14 inches; dark yellowish brown (10YR 4/4) silt loam; dark brown (10YR 4/3) coatings on faces of peds; moderate fine subangular blocky structure; friable; few thin dark brown (10YR 3/3) clay films; neutral; clear smooth boundary.

Bt2—14 to 25 inches; dark yellowish brown (10YR 4/4) silt loam; dark brown (10YR 4/3) coatings on faces of peds; moderate medium subangular blocky structure parting to strong fine and very fine subangular blocky; friable; few thin dark brown (10YR 3/3) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3—25 to 33 inches; dark yellowish brown (10YR 4/4) silt loam; dark brown (10YR 4/3) coatings on faces of peds; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few thin to moderately thick dark brown (10YR 3/3) clay

films on faces of peds; strongly acid; clear smooth boundary.

BC1—33 to 54 inches; brown (10YR 5/3) silt loam; moderate coarse prismatic structure parting to moderate fine subangular blocky; firm; few thin to moderately thick dark brown (10YR 3/3) clay films on faces of peds; strongly acid; gradual smooth boundary.

BC2—54 to 60 inches; brown (10YR 5/3) silt loam; common fine prominent strong brown (7.5YR 5/8) mottles; moderate coarse prismatic structure parting to moderate coarse subangular blocky; friable; few thick very dark grayish brown (10YR 3/2) clay films in tubular pores; strongly acid.

The solum ranges from 36 to 72 inches in thickness. The Ap horizon has value of 3 or 4 moist and value of 6 or more dry. It has chroma of 2 or 3. In pedons that are not cultivated, an A horizon 2 to 4 inches thick and an E horizon 4 to 7 inches thick are present. The A and E horizons are neutral through medium acid. A BA horizon is present in some pedons. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. In some pedons it has mottles with chroma of 2 or less below a depth of 30 inches. The Bt horizon is medium acid or strongly acid. The BC horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 through 4.

Seaton soils that have slopes of more than 20 percent are outside the range defined for the Seaton series because the surface is loam and the profile contains more sand. These differences, however, do not affect the usefulness or behavior of the soils.

Shiloh Series

The Shiloh series consists of deep, very poorly drained, slowly permeable soils in depressions on flood plains along the Mississippi River. These soils formed in silty and clayey alluvial sediment. Slope is less than 1 percent.

Shiloh soils are similar to Colo soils and are associated on the landscape with Comfrey soils. Colo soils contain less clay than Shiloh soils and are on the more elevated positions. Comfrey soils contain more sand and are on slightly elevated positions.

Typical pedon of Shiloh silty clay, ponded; 1,300 feet north and 3,800 feet east of the southwest corner of sec. 26, T. 104 N., R. 4 W.

A1—0 to 16 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

A2—16 to 25 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine prominent light olive brown (2.5Y 5/6) mottles; weak very fine subangular blocky structure; firm; slightly acid; gradual smooth boundary.

Cg—25 to 60 inches; very dark gray (10YR 3/1) silty clay loam; few fine prominent light olive brown (2.5Y 5/6) mottles; weak very fine subangular blocky structure; firm; mildly alkaline.

The mollic epipedon ranges from 24 to 48 inches or more in thickness. The A horizon has value of 2 or 3. It is silty clay or silty clay loam and is slightly acid or neutral. The C horizon has hue ranging from 10YR through 5Y, value of 3 or 4, and chroma of 0 or 1. It is silty clay or silty clay loam and is neutral or mildly alkaline.

Shullsburg Series

The Shullsburg series consists of moderately deep, somewhat poorly drained, slowly permeable soils on narrow ridges in dissected uplands. These soils formed in a thin mantle of loess and in the underlying clayey residuum weathered from Decorah Shale. Slope ranges from 1 to 12 percent.

Shullsburg soils are associated on the landscape with Edmund, Frankville, and Massbach soils. These soils are on positions similar to those of Shullsburg soils. Edmund and Frankville soils are underlain by clayey and clayey-skeletal residuum overlying limestone or dolomite. Massbach soils have a thicker loess mantle than Shullsburg soils.

Typical pedon of Shullsburg silt loam, 6 to 12 percent slopes; 1,600 feet west and 2,120 feet north of the southeast corner of sec. 9, T. 101 N., R. 6 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

Bt1—9 to 16 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) mottles; moderate fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

2Bt2—16 to 22 inches; light olive brown (2.5Y 5/4) silty clay; common fine faint grayish brown (2.5Y 5/2) and common fine prominent strong brown (7.5YR 5/6) mottles; strong coarse prismatic structure parting to moderate medium angular blocky; firm; slightly acid; clear wavy boundary.

2Cr—22 to 60 inches; pale olive (5Y 6/4) clay, weathered from shale; laminated; very firm; slightly acid.

Thickness of the solum and depth to shale bedrock are 20 to 40 inches. The loess mantle is 15 to 30 inches thick. That part of the solum developed in residuum is 6

to 18 inches thick. The mollic epipedon is 9 to 18 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or silty clay loam and is medium acid through neutral. That part of the B horizon formed in loess has chroma of 2 through 4. It is silt loam or silty clay loam and is slightly acid or neutral. The 2B horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 through 4. It is slightly acid or neutral. The 2Cr horizon has value of 5 or 6 and chroma of 2 through 4.

Sogn Series

The Sogn series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands (fig. 16). These soils formed in a thin mantle of loess over fragmented limestone. Slope ranges from 2 to 12 percent.

The Sogn soils in Houston County are outside the range defined for the Sogn series because they are underlain by fractured limestone and are in a wetter climate. These differences, however, do not alter the usefulness or behavior of the soils.

Sogn soils are associated on the landscape with Brodale, Edmund, and Lacrescent soils. Brodale and Lacrescent soils formed in loamy-skeletal colluvium, are deeper to bedrock than Sogn soils, and are on the steep and very steep sides of ridges. Edmund soils formed in clay residuum and are on positions similar to those of Sogn soils.

Typical pedon of Sogn silt loam, 2 to 12 percent slopes; 250 feet east and 1,150 feet north of the southwest corner of sec. 35, T. 101 N., R. 7 W.

A1—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and very fine granular structure; very friable; neutral; clear smooth boundary.

A2—8 to 14 inches; very dark grayish brown (10YR 3/2) very flaggy loam, dark brown (10YR 3/3) dry; moderate fine and very fine granular structure; very friable; about 70 percent coarse fragments; neutral; abrupt wavy boundary.

R—14 inches; highly fractured limestone.

Thickness of the solum and depth to hard bedrock range from 8 to 20 inches. The loess mantle is 6 to 15 inches thick. Pebbles and cobbles of limestone make up 0 to 80 percent of the soil, by volume. The A horizon has value of 2 or 3 and chroma of 1 through 3. It is loam or silt loam and is neutral or slightly acid.

Southridge Series

The Southridge series consists of deep, well drained soils on narrow ridges in dissected uplands. These soils formed in a mantle of loess and the underlying clayey erosional sediment or residuum from dolomite.

Figure 16.—Profile of Sogn silt loam, 2 to 12 percent slopes, formed in flaggy Platteville limestone. Below this is about 12 inches of Glenwood shale. The massive underlying rock is St. Peter sandstone.

Permeability is moderate in the loess and slow in the underlying residuum. Slope ranges from 3 to 20 percent.

The Southridge soils in Houston County are mapped only in complex with Blackhammer soils. Southridge soils are similar to and are associated on the landscape with Blackhammer, Rollingstone, and Seaton soils. They are also similar to Valton soils. All of these soils are on positions similar to those of Southridge soils. Blackhammer soils have a subsoil formed in loamy erosional sediment. Rollingstone soils have a thinner mantle of loess than Southridge soils. Seaton soils have a thicker mantle of loess. Valton soils do not have a mollic epipedon.

Typical pedon of Southridge silt loam, in an area of Blackhammer-Southridge silt loams, 12 to 20 percent

slopes; 300 feet south and 2,520 feet west of the northeast corner of sec. 23, T. 103 N., R. 6 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; friable; few masses of brown (10YR 4/3); medium acid; clear smooth boundary.
BA—8 to 16 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure parting to weak fine subangular blocky; friable; few thin dark brown (10YR 3/3) clay films and few thin brown (10YR 4/3) porous coatings on faces of peds; strongly acid; clear smooth boundary.
Bt1—16 to 33 inches; yellowish brown (10YR 5/4) silt loam; dark yellowish brown (10YR 4/4) coatings on faces of peds; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common thin dark brown (10YR 3/3) clay films on faces of peds; common moderately thick very dark grayish brown (10YR 3/2) clay films along pores; common very fine roots; very strongly acid; abrupt smooth boundary.
2Bt2—33 to 60 inches; reddish brown (5YR 4/6) clay; strong coarse angular blocky structure parting to strong medium and fine angular blocky; very firm; common moderately thick and thick very dark brown (10YR 2/2) clay films along pores and on faces of peds; 5 percent chert fragments; strongly acid.

Thickness of the solum, depth to dolomite bedrock, and depth to free carbonates range from 60 to 100 inches or more. Thickness of loess ranges from 15 to 40 inches. The content of chert coarse fragments is 5 to 25 percent in the clayey residuum.

The Ap horizon is 7 to 10 inches thick. It has value of 3 or 4 moist and 6 or more dry and has chroma of 2 or 3. The A horizon is commonly silt loam, but in some pedons it is silt. It is slightly acid or medium acid. In pedons that are not cultivated, an A horizon 2 to 4 inches thick and an E horizon 3 to 7 inches thick are present. The B horizon in the loess mantle has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam and is very strongly acid through slightly acid. The 2Bt horizon typically has hue of 5YR, but the hue ranges through 7.5YR. The 2Bt horizon ranges in value and chroma from 4 through 6. It averages 55 to 80 percent clay and is strongly acid or medium acid.

Sparta Series

The Sparta series consists of deep, excessively drained, rapidly permeable soils on terraces. These soils formed in sandy alluvium. Slope ranges from 0 to 6 percent.

Sparta soils are associated on the landscape with Billett, Dickinson, and Plainfield soils. Billett and Dickinson soils are coarse-loamy. Plainfield soils do not have a mollic epipedon. All these soils are on positions similar to those of Sparta soils.

Typical pedon of Sparta loamy sand, 0 to 6 percent slopes; 2,125 feet west and 2,540 feet south of the northeast corner of sec. 26, T. 104 N., R. 6 W.

A—0 to 20 inches; very dark brown (10YR 2/2) loamy sand, grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; neutral; clear smooth boundary.
BA—20 to 30 inches; dark brown (10YR 4/3) loamy sand; few very dark grayish brown (10YR 3/2) masses; weak medium subangular blocky structure parting to weak very fine granular; very friable; medium acid; clear smooth boundary.
Bw—30 to 38 inches; dark yellowish brown (10YR 4/4) loamy sand; thin coatings of very dark grayish brown (10YR 3/2) on faces of peds; weak medium subangular blocky structure; very friable; medium acid; clear smooth boundary.
C1—38 to 46 inches; yellowish brown (10YR 5/4) sand; single grain; loose; medium acid; clear smooth boundary.
C2—46 to 60 inches; brown (10YR 5/3) sand; single grain; loose; medium acid.

The solum ranges from 24 to 40 inches in thickness. The mollic epipedon is 10 to 24 inches thick.

The A horizon has value of 2 or 3. It is loamy sand, loamy fine sand, or sand and is neutral through medium acid. The B horizon has value of 4 or 5 and chroma of 3 through 5. It is sand, fine sand, loamy sand, or loamy fine sand and is medium acid or strongly acid. The C horizon has value of 5 or 6 and chroma of 3 through 5. It is sand or fine sand.

Terril Series

The Terril series consists of deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in loamy and sandy alluvial sediment. Slope ranges from 1 to 4 percent.

Terril soils are similar to and are associated with Arenzville, Becker, and Rawles soils. Arenzville and Becker soils are on positions similar to those of Terril soils. Rawles soils are on lower positions. Arenzville soils have a thick mantle of recently deposited silty erosional sediment, Becker soils are coarse-loamy, and Rawles soils are fine-silty.

Typical pedon of Terril loam, sandy substratum; 975 feet west and 1,425 feet north of the southeast corner of sec. 33, T. 104 N., R. 7 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure;

friable; many fine and very fine roots; slightly acid; abrupt smooth boundary.
A1—8 to 20 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; many fine and very fine roots; slightly acid; gradual smooth boundary.
A2—20 to 27 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; moderate fine subangular blocky structure; friable; many very fine roots; slightly acid; gradual smooth boundary.
A3—27 to 36 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; common fine roots; slightly acid; gradual smooth boundary.
Bw—36 to 46 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; few very fine roots; slightly acid; clear smooth boundary.
2BC—46 to 58 inches; brown (10YR 4/3) loamy sand; weak coarse subangular blocky structure; very friable; slightly acid; clear smooth boundary.
2C—58 to 60 inches; stratified brown (10YR 4/3) and black (10YR 2/1) sand; single grain; loose; mildly alkaline.

Thickness of the solum and the loamy mantle is 40 to 60 inches. Depth to free carbonates is 50 to 80 inches. The surface layer and subsoil are medium acid through neutral.

The A horizon has value of 2 or 3 and chroam of 1 or 2. It typically is loam but ranges to silt loam. The B horizon has value and chroma of 3 or 4. It typically is loam but ranges to silt loam. The 2C horizon is stratified sand, fine sand, loamy sand, or loamy fine sand.

Timula Series

The Timula series consists of deep, well drained, moderately permeable soils on moderately steep to very steep side slopes of stream terraces. These soils formed in thick silty alluvium. Slope ranges from 12 to 70 percent.

Timula soils are associated on the landscape with Festina soils. Festina soils contain more clay than Timula soils and are on terraces that have more gentle slopes.

Typical pedon of Timula silt loam, 20 to 40 percent slopes; 2,400 feet east and 2,030 feet south of the northwest corner of sec. 16, T. 103 N., R. 6 W.

Ap—0 to 10 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.
Bw—10 to 28 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; few thin dark yellowish brown (10YR 4/4) coatings on faces of peds; slightly acid; clear smooth boundary.
BC—28 to 34 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; few thin dark yellowish brown (10YR 4/4) coatings on faces of peds; few thin dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear smooth boundary.
C—34 to 60 inches; light olive brown (2.5Y 5/4) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; strong effervescence; mildly alkaline.

Thickness of the solum and depth to free carbonates range from 18 to 36 inches. The solum is slightly acid or neutral.

The A horizon has value of 3 or 4. The B horizon has value of 4 or 5. The A horizon and upper part of the B horizon in many pedons contain more than 18 percent clay, but the control section has 12 to 18 percent clay. The C horizon has value of 5 or 6 and chroma of 3 or 4.

Valton Series

The Valton series consists of deep, well drained soils on ridges in dissected uplands. These soils formed in a mantle of loess and the underlying clayey erosional sediment or residuum from dolomite. Permeability is moderate in the loess mantle and slow in the clayey subsoil. Slope ranges from 6 to 20 percent.

Valton soils in Houston County are mapped only in complex with Newhouse soils. Valton soils are associated on the landscape with Mt. Carroll and Newhouse soils and are similar to Nasset and Southridge soils. All of these soils are on positions similar to those of Valton soils. Mt. Carroll soils formed in deep loess. Nasset soils have a clayey-skeletal horizon within a depth of 60 inches. Newhouse soils have a subsoil formed in loamy erosional sediment. Southridge soils have a lighter colored surface layer.

Typical pedon of Valton silt loam, in an area of Newhouse-Valton silt loams, 12 to 20 percent slopes; 1,200 feet south and 1,300 feet east of the northwest corner of sec. 22, T. 102 N., R. 6 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; very dark brown (10YR 2/2) coatings on faces of peds; slightly acid; abrupt smooth boundary.
AB—9 to 21 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure parting to moderate fine subangular blocky; friable; slightly acid; clear smooth boundary.
Bt1—21 to 28 inches; yellowish brown (10YR 5/4) silt loam; moderate coarse subangular blocky structure parting to moderate medium subangular blocky;

friable; few thin discontinuous clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—28 to 33 inches; yellowish brown (10YR 5/4) silt loam; moderate coarse subangular blocky structure; friable; few thin dark brown (10YR 3/3) clay films on faces of peds and in pores; strongly acid; abrupt smooth boundary.

2Bt3—33 to 60 inches; yellowish red (5YR 4/6) clay; strong coarse prismatic structure parting to strong fine and very fine subangular blocky; very firm; thick clay films on faces of peds; about 10 percent chert fragments; strongly acid.

Thickness of the solum and depth to free carbonates range from 60 to 100 inches or more. Thickness of the loess mantle ranges from 15 to 36 inches. Depth to dolomite bedrock typically is 60 to 90 inches but ranges to 120 inches or more in some pedons. The content of chert fragments is 5 to 25 percent in the clayey sediment or residuum.

The Ap horizon has value and chroma of 2 or 3. In pedons that are not cultivated, an E horizon 1 to 4 inches thick is present. The Bt horizon in the loess mantle has value of 4 or 5 and chroma of 3 or 4. It is medium acid or strongly acid. The 2Bt horizon typically has hue of 5YR but ranges from 2.5YR through 7.5YR. It has value of 4 or 5 and chroma of 3 to 8. It is medium acid through very strongly acid.

Walford Series

The Walford series consists of deep, poorly drained soils on terraces and uplands. These soils formed in silty alluvium. On uplands, the soils occupy the upper reaches of drainageways; on terraces, the soils are on broad plane surfaces or in shallow drainageways. Permeability is moderately slow. Slope ranges from 0 to 3 percent.

Walford soils are associated on the landscape with Festina soils. Festina soils are well drained and are on flats and side slopes of terraces.

Typical pedon of Walford silt loam; 2,360 feet east and 20 feet south of the northwest corner of sec. 12, T. 104 N., R. 7 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bg—9 to 18 inches; grayish brown (2.5Y 5/2) silt loam; few fine distinct olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure parting to moderate very fine subangular blocky; friable; slightly acid; clear smooth boundary.

Btg1—18 to 24 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; friable; few thin clay films on faces of peds; medium acid; clear smooth boundary.

Btg2—24 to 34 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/8) mottles; moderate medium and coarse prismatic structure parting to moderate coarse subangular blocky; friable; few thin very dark grayish brown (2.5Y 3/2) clay films on faces of peds; medium acid; clear smooth boundary.

BCg—34 to 43 inches; olive gray (5Y 5/2) silt loam; common fine and medium prominent yellowish brown (10YR 5/8) and light olive gray (5Y 6/2) mottles; moderate coarse prismatic structure parting to moderate very coarse subangular blocky; friable; few moderately thick very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; medium acid; clear smooth boundary.

Cg—43 to 60 inches; light olive gray (5Y 6/2) silt loam; common fine prominent olive yellow (2.5Y 6/6) mottles; weak thin platy structure; friable; few thin very dark grayish brown (2.5Y 3/2) and common fine black (10YR 2/1) and very dark grayish brown (2.5Y 3/2) clay films on horizontal faces of peds and in root channels; medium acid.

The solum is 40 to 60 inches thick. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. An A horizon 3 to 6 inches thick and an E horizon 2 to 5 inches thick are in some pedons. The A horizon is neutral through medium acid. The Btg horizon has value of 4 or 5 in the upper part and 5 or 6 in the lower part. It is silt loam or silty clay loam and is medium acid or strongly acid. The BC horizon and the C horizon have hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 or 3. They are medium acid or strongly acid.

Zwingle Variant

The Zwingle Variant consists of deep, poorly drained, very slowly permeable soils on terraces along the lower reaches of streams or rivers. These soils formed in clayey lacustrine sediment and the underlying stratified alluvial sediment. Slope ranges from 0 to 2 percent.

Zwingle Variant soils are associated on the landscape with Festina soils. Festina soils contain silt and are on positions similar to those of the Zwingle Variant soils.

Typical pedon of Zwingle Variant silty clay, 0 to 2 percent slopes; 500 feet north and 600 feet east of the southwest corner of sec. 27, T. 102 N., R. 4 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silty clay, gray (10YR 6/1) dry; weak very fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

BA—6 to 11 inches; grayish brown (2.5Y 5/2) clay; strong medium angular blocky structure parting to strong fine and very fine angular blocky; very firm; dark grayish brown (2.5Y 4/2) coatings on faces of peds; very strongly acid; gradual smooth boundary.

Bt1—11 to 19 inches; olive gray (2.5Y 5/2) clay; common fine prominent yellowish brown (10YR 5/8) mottles; strong fine angular blocky structure parting to strong very fine angular blocky; very firm; continuous moderately thick clay films on faces of peds; very strongy acid; clear smooth boundary.

Bt2—19 to 47 inches; strata and intermixed masses of pale olive (5Y 5/2) and reddish brown (5YR 5/4) clay; common fine and medium prominent yellowish brown (10YR 5/8) mottles; strong medium angular blocky structure parting to strong very fine angular blocky; very firm; few thin clay films on faces of peds; strongly acid; clear smooth boundary.

C—47 to 60 inches; light olive gray (2.5Y 6/2) stratified silty clay, silty clay loam, and silt loam; many fine to medium prominent yellowish brown (10YR 5/6) mottles; strong medium and fine subangular blocky structure; firm in the silty clay and silty clay loam strata, friable in the silt loam strata; few thin strata of reddish brown (5YR 5/4) silty clay loam; strong effervescence; mildly alkaline.

Thickness of the solum ranges from 40 to 65 inches. Depth to free carbonates ranges from 40 to 60 inches or more.

The Ap horizon has value of 4 or 5 and chroma of 1 or 2. An A horizon 2 to 5 inches thick and an E horizon 4 to 7 inches thick are in some pedons. The A horizon is silty clay or silty clay loam. It is neutral through strongly acid. The Bt horizon has hue of 2.5YR through 5Y, value of 4 through 6, and chroma of 2 through 4. It is medium acid through very strongly acid. The C horizon has hue of 2.5YR through 5Y, value of 5 or 6, and chroma of 0 to 4. It has strata of silty clay, silty clay loam, or silt loam and is neutral through moderately alkaline. Some pedons have a 2C horizon below a depth of 40 inches. It is stratified in color and texture.

Landscape Evolution

The ridge and valley landscape of Houston County is the eroded remnants of an ancient plain that covered southeastern Minnesota and the adjacent states. The development of the ridges and valleys from the ancient plain has spanned eons of time. Geologists divide this time frame based on rock minerology and fossils. A sequence of events shaped the present-day landscape.

About 600 million years ago, a series of shallow seas began to invade or transgress the subsiding parts of the continent. The subsidence was caused by uplift in other parts of the earth. The onset of this invasion marks the beginning of the Cambrian Period.

Later during the Ordovician Period, greater invasions of the sea took place and about 70 percent of the North American Continent was under water. The Cambrian and Ordovician Periods are the earliest members of the Paleozoic Era (*12*). During Cambrian and Ordovician time, streams carried upland sediment to the seas. The kinds of minerals and particle size of the sediment were dependent upon the chemical and physical makeup of the upland material and on the nearness to the mineral source. The source probably varied with time as surrounding lands were elevated or lowered by subsidence or erosion (*3*). During the Cambrian time, the sediment was mostly sandy (fig. 17). Ordovician sediment was characterized more by the deposition of limy mud, a mixture of minerals, and the remains of teeming plant and animal life.

Mollusks, mostly clamlike animals that contained large amounts of calcium and magnesium carbonates in their shells, were common.

With the recession of the seas, the sediment was cemented and compressed into rock. The sandy sediment formed sandstone, and the limy mud formed limestone or shale, depending on their mineral composition. In Houston County the nearly level beds of sediment accumulated to a thickness of about 1,500 feet of rock. This rock covered the basement granitic rock. The granite formed during upswelling of hot liquid rock or magna from the earth's interior. At Winona, well borings show the basement rock is at a depth of nearly 500 feet below the Mississippi River.

Near the end of the Ordovician Period, about 435 million years ago, mountain building in the eastern part of the United States raised the elevation of the sea floor in the upper Mississippi Valley above sea level. The recession of the seas left a broad, nearly level plain. During the next 300 to 350 million years, weathering and erosional forces were active upon the emergent plain.

The next recorded event in Houston County occurred during the "Age of Dinosaurs," the Cretaceous Period. The temperature of the region at this time is uncertain. Regardless of the temperature, the climate was very humid overall. This was due to a large eastward moving Cretaceous Sea, 1,500 to 2,000 miles wide, which had its eastern shores in western Minnesota (*11*).

Figure 17.—Jordan sandstone exposed in a roadbank. This formation is the uppermost formation of the Cambrian System. It is an important source of water in Houston County.

During the Early to Middle Cretaceous, the nearly level landscape (which was at most only 300 feet above sea level in Houston County) began to weather deeply (*11*). Because of the wet humid conditions, water entering cracks in rocks actively dissolved the underlying carbonate rock and formed extensive Karst topography. This weakly dissected broad Karst plain had a complex surface and subsurface drainage system. Weathered rock material was transported by surface streams and drainageways into sinkholes and through caves only to re-emerge at the surface as springs at a slightly lower elevation. Additional weathered rock sediment from northern and central Wisconsin was transported to the area by rivers flowing to the Cretaceous Sea. All of this weathered material in time produced a thick clayey sediment that covered the entire landscape. These sediments, known as the Iron Hill member of the Windrow Formation, were greatly influenced by the local underlying bedrock on which the sediments were deposited. For example in Blackhammer and Nodine soils, the Cretaceous sediment was deposited on and infiltrated the weathered New Richmond sandstone, thus giving the sediment a sandier character. In Southridge and Rollingstone soils, the Cretaceous sediment was deposited on the Willow River and Oneota dolomites, from which most of the chert within these red clayey soils originated. On top of the St. Peter sandstone only a very hard iron cemented duricrust remains today as evidence of this deposition cycle. This weathering and deposition cycle ended about 90 million years ago (*11*). About 70 million years ago, near the end of the Cretaceous Period, the landscape began to rise. Eventually, it rose as much as 1,000 feet. This rise in the landscape resulted from the uplift of the Rocky Mountains. The climate became drier during this time.

The next major event to significantly shape the landscape was the Pleistocene Epoch, known as the ice age.

About 2 to 3 million years ago, ice fields began to form in the polar and mountainous regions and radiated outward. The uplands of Houston County were affected only by the earliest glaciations. Ice reached into the western part of the county. In the extreme northwestern part of the county, a thin mantle of limy, yellowish brown, loam glacial drift persists. Scattered igneous and metamorphic pebbles from northern Minnesota and Canada are all that remain as evidence of glaciation in the western part of the county.

As the ice melted, torrential flows of water carved into the bedrock surface. It was during this early glacial time that the landscape evolved from the nearly level plain to the mature ridge and valley topography observed today. Pleistocene erosion caused an escarpment slope to form on the soft easily eroded St. Peter sandstone. This escarpment divided the ancient Cretaceous plain into two distinct surfaces. In Houston County, erosion has stripped away the upper plain, and all that remains are a few narrow ridges and mesas in the southwestern part of the county. Capping the St. Peter sandstone are in ascending order: Glenwood shale, Platteville limestone, Decorah shale, and the lower part of the Galena Formation (fig. 18).

The lower plain, or Prairie du Chien surface, is 75 to 100 feet below the ridges and mesas. It is the largest upland surface in the county. The greatest dissection of this plain is in the eastern and northern parts of the county. There the ridges are narrow and cut into stepped levels to the valley side slopes somewhat like a staircase. All members of the Prairie du Chien Group, namely, the Willow River and New Richmond Members of the Shakopee and Oneota Formations, form the bedrock surface at some point on the landscape.

The Prairie du Chien surface is mantled with a thick, mostly stratified sediment that is as much as 35 feet or more in thickness according to the Minnesota State Highway Department. The sediment is thickest on the ridgetops and becomes thinner downslope. The sediment is believed to be derived from the long-time weathering and associated erosion of the bedrock surface between the retreat of the seas and the onset of the glacial age. Part of the sediment may have been transported from the St. Peter-Galena surface. Sediment was deposited near the front of the escarpment slope as erosion wasted the upper plain. For example, in places sediment on the Prairie du Chien surface has several feet of olive shale strata similar to the Decorah shale on the Galena-St. Peter surface. The sediment, however, is mostly yellowish red to reddish brown and strongly acid to extremely acid in reaction. Texture is extremely variable, ranging from sandy to very clayey. The sediment contains an abundance of chert pebbles and cobbles.

About 300,000 years ago the climate began to cool. Ice fields formed in the polar and mountainous regions and began to radiate outward. Four major glaciations with many substages covered much of the northern part of the United States. Because of a bedrock high, the uplands of Houston County were affected by only the earlier glaciations. Kansan and Nebraskan glaciation reached into the western part of the county. Except for the extreme northwestern part of the county, glacial ice in itself probably did little to alter the landscape. There, a mantle of limy, yellowish brown, loam glacial drift up to 10 feet thick persists on the Prairie du Chien ridge surface. In other areas scattered pebbles of granitic rock or pebbles, characteristic of rock in the northeastern part of the state, remain as evidence of glaciation.

The frigid glacial climate accelerated the erosional processes. Seasonal thawing of the permafrost caused mud slides. Repeated slides have contributed to the stratification and mixing of materials. Erosion was most intense on the sides and lower ridge summits. Erosion truncated or removed the soils and some of the underlying sediment. On a ridge summit, about 4 miles

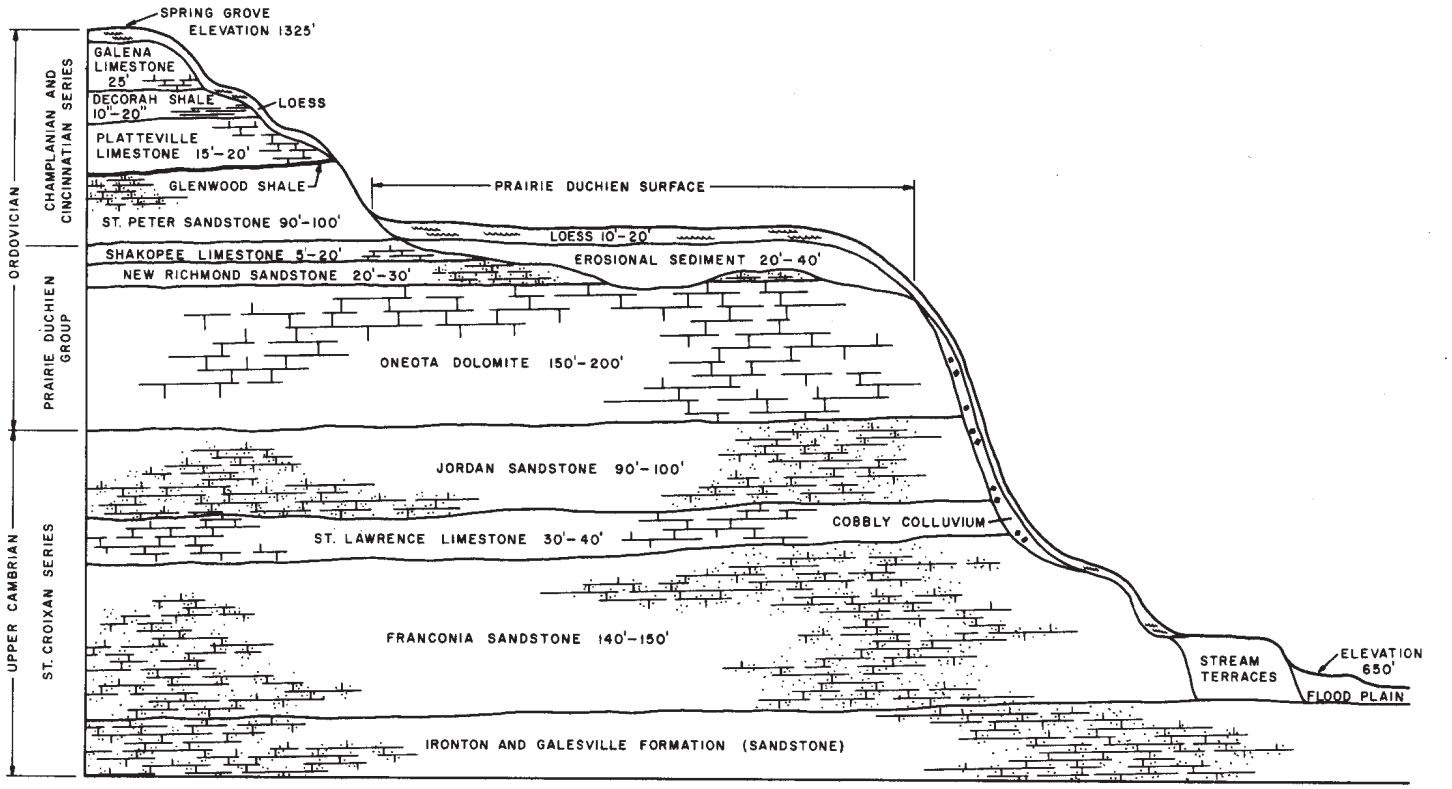

Figure 18.—Geologic cross section of Houston County in a west to east direction.

northwest of Caledonia buried under 20 feet of loess, is a soil with a surface layer intact.

Valleys continued to widen, deepen, and lengthen. Streams continued to carve their way headward into the landscape. They intercepted many solution cavities in limestone and dolomite layers. Rock was easily removed from these settings. Gravitational forces carried the rock downslope, smoothing the fragments into cobbles and pebbles. This cobbly loamy colluvium is coarser textured and thinner near the shoulder slope and is finer and thicker near the foot slopes. In many places on the foot slopes, the cobbly loamy colluvium is 10 feet or more in thickness.

Although ice left its mark on landscapes of Houston County, the major impact of the ice age or Pleistocene was made by wind. During the latter stages of the ice age, called the Wisconsin stage, intense winds carried loess onto the landscapes. The mostly silt-sized particles were deposited on the deeply dissected land surface much like a blanket of snow during winter storms. The loess was deposited between 12,000 and 26,000 years ago (*8*). It is as much as 25 feet thick on the broader summits and becomes thinner as ridges narrow and slope increases. Where slope gradient and width of ridges are equal, the loess is thinnest on northwest aspects and thickest on southeast aspects. The main source of the loess was the valley floors of the Mississippi River and its tributaries (*8*). A source of some of the loess was the ice fields to the north and west at that time.

The Pleistocene age ended with the warming of the climate about 10,000 to 15,000 years ago. Massive ice fields to the north and west melted. Torrential flows of melt water swelled streams that served as melt water outlets. The Mississippi River bed rose at times to a height as much as 70 feet or more above the present flood plain. Large quantities of gravel and sand carried from the ice fields were deposited as outwash or valley train. Later successive river incisement left these coarse textured materials as benches or terraces. The town of La Crescent is built on one of these glacial terraces. The glacial terraces along the Mississippi River do not have a mantle of silt because loess deposition had ceased before melting of the youngest glaciers had begun. The Lamont and Lilah soils formed in these coarse textured deposits. As streamflow increased, water invaded the lower valleys of tributary streams and rivers. Flooding was not confined to areas near the main channel of the Mississippi River.

During this period the loess blanket covering the sediment on the ridges and foot slopes was partially stripped. Much of the eroded loess was deposited in

valleys below thin strata, mostly of silt. The Festina soils formed in this sediment. The lower reaches of streams entering the Mississippi River were covered with deep backwater. Where water covered the flood plains to a considerable depth, clay was deposited. Some of the clay is probably related to glacial blockage and a change in the course of the river in the Rock Island, Illinois, area. The Zwingle Variant soils formed in this clay sediment. The newly deposited sediment covered terraces formed during earlier times, although boring in narrow valleys has not encountered sediment of contrasting mineralogy or texture within a depth of 15 feet.

Shortly after deposition of the silty and clayey sediments, strata of sands were deposited along the Root River and its South Branch. The sands do not have a loess cover. The origin of these deposits and the lack of loess cover is unexplained at this time.

About 8,000 to 10,000 years ago the glacial ice retreated, and the sediment-laden, torrential flows ceased. The water level in the Mississippi River and its tributaries fell, and a new incisement cycle, enhanced by a much reduced sediment load, began in the valleys. Tributary streams cut into their flood plains, adjusting to the lowered water level of the Mississippi River. In a relatively short time period, a large portion of the flood plains of glacial times were removed. Narrow, dissected terraces, mere remnants of the former alluvial plain, are all that remain.

During the past 8,000 years, sediment has been deposited on the floor of the recent flood plains. No dramatic changes in the environment took place until the arrival of European settlers about 125 years ago. Breaking up of the protective covering of sod and forest litter by the settlers accelerated the erosion processes. This period is discussed briefly in "Crops and Pasture."

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Formation of the Soils

Soils are formed by processes generated by the interaction of parent material, climate, time, plant and animal life, and landscape setting. The interaction of these factors generates complex chemical, physical, and biological processes, many of which are mutually dependent. As a result of the multitude of processes working through time, definite layers or horizons form in the soil. These layers, surface, subsurface, subsoil, and substratum, are defined in the Glossary.

Parent Material

Parent material largely determines the physical and chemical properties of the soil, such as the capacity or ability of the soil to store water and nutrients for plants and the rate at which water can pass through the soil. The soils on the ridges in Houston County formed in loess, loess and erosional sediment or residuum, colluvium, alluvium on terraces and flood plains, wind-deposited eolian sands, and organic matter.

Climate

Climate influences soil formation by providing moisture and heat necessary for the weathering of parent material. Water dissolves soluble materials and transfers nutrients to lower parts of the soil. Water also is needed to alter minerals to clay and transfer the clay to lower layers. Reaction or pH is largely influenced by climate. Temperature affects the rate at which chemical reactions proceed. Chemical reactions are slower at freezing than at a higher temperature. Moisture and temperature affect the kind of plants that grow on the soil. Further organic matter accumulation and decomposition are influenced by moisture and temperature as well as vegetation.

Climate is modified by landscape setting and parent material. Relatively large amounts of water are available for soil forming processes in loess on the ridge summits. Little is available for plants where the soil is sandy and much of the rainfall passes through the soil rapidly or where slopes are steep and water runs off quickly. Climate may not remain constant throughout the development of the soil. Where drastic changes have taken place, soil forming processes may have been altered and a new cycle of soil formation began. When this happens, climate modifies the time factor, for the age of the new soil must be measured from the beginning of the climatic change.

Time

Time is required by climate, by plants, and by animals to form soil from parent material. Various soils have formed over periods of time ranging from a few years to thousands of years. Time is modified by the other factors of soil formation.

The length of time in which soils are exposed at the surface is a modifying factor in soil formation. Soils can be no older than the age of the landscape surface upon which they form (*9*). Not all the soils forming the surface of the landscape in Houston County are the same age. Landscapes erode back from their base level (Mississippi River) along streams and rivers to near the landscape summit. The summits remain stable, little affected by erosive forces. Carbonates are deeply leached, and the soils are well developed and are relatively older than soils downslope. Downslope erosion over long periods of time has exposed fresh material. The Franconia sandstone, for example, was exposed to weathering much later in time than the sediment overlying the Oneota dolomite several hundred feet higher on the landscape. The Norden soil formed on the Franconia Formation is therefore younger than the Rollingstone soil on the Oneota Formation.

Another factor modifying time is the rate that parent material can be transformed into soils. The small particles in loess, for example, weather relatively rapidly. On the other hand, the larger particles in sandstone and in the sandy sediment on stream terraces have a high proportion of slowly weatherable quartz and are transformed very slowly into soils that have distinct layers.

Landscape setting modifies the time factor because rainfall runs rapidly off steep slopes. Only a small amount of water enters the soil to form clay or leach carbonates and other soluable material. Time is modified also by the effects of climate. Assuming all other factors are equal, soils form more rapidly in warm, humid climates than in Houston County, where the soil forming process is reduced much of the year.

Plant and Animal Life

Living organisms, both plant and animal, affect soil formation by providing organic matter and transferring nutrients from the lower layers of the soil to the upper

layers. Plants influence the development of specific layers in the soil. Vegetation influences the rate clay is transferred from the surface layers to the subsoil. Plants and animals are related to other factors of soil formation, such as soil microclimate, parent material, and landscape setting, all of which collectively can determine the vegetation growing upon a soil.

Landscape Setting

The term landscape setting involves many facets. Landscape setting indicates the broad location of the soil, such as ridgetop, terrace, or flood plain. It also includes such characteristics as slope gradient, length, shape, uniformity, and aspect. Landscape setting interelates to climate by affecting runoff, which influences the amount of moisture available for soil forming processes and the removal of material by erosion. Where runoff is very rapid, as on a steep slope, soil formation proceeds slowly. Where runoff is slow, moisture may be abundant and soil formation proceeds at a faster rate.

Process of Soil Formation and Development of Soils

Horizons or distinct layers were formed in the soils of Houston County by many processes; mainly the leaching of carbonates and salts, accumulation of organic matter, formation and transfer of clay, oxidation of iron, and reduction or transfer of iron.

Soils Formed On Ridgetops

The first steps in forming soil from limestone bedrock are the removal of calcium and magnesium and the oxidation of iron. Calcium and magnesium are abundant in the limestone from which some of the present soils formed. Small amounts of silica, iron, and aluminum in the soil are important.

Water is an essential element in calcium and magnesium removal. Weak acids, such as carbonic acid, form at the soil surface in the presence of water and organic matter. These acid waters percolate down through cracks and fissures in the bedrock and by attacking exposed mineral surfaces free the calcium and magnesium. Iron that is freed by the breakdown of the bedrock combines with water and oxygen and forms hydrated iron oxides that give strong reddish colors to the soils. Some of the water combines with the freed magnesium and calcium and oxygen, silica, and aluminum to form clay minerals. In time, the clay minerals and other weathering products fill fissures and cracks and accumulate on the surface. The clay shrinks and swells as soil moisture changes, causing blocky and prismlike structures to form. After carbonates are completely destroyed, translocation of very fine clay takes place. This clay moves downward and covers the surfaces of prisms and blocks with a thin waxy film of clay oriented as thin plates. This forms a subsoil, such as that in the Frankville and Southridge soils.

Where sandstone was the parent material, such as the Jordan sandstone, the soil is mostly sandy and contains little clay. Boone soils formed in sandstone. Where the soils formed in Decorah shale, chemical weathering has been relatively weak. The shale is so impervious that little water and oxygen can pass through the soil to remove the calcium and magnesium carbonates and oxidize the iron. The shale is leached of calcium and magnesium and oxidized to a very shallow depth. This material forms the lower part of the subsoil of Shullsburg and Massbach soils.

The soils formed by the weathering of bedrock have been largely removed by intense erosional processes, and new soils have formed during periods when the erosional processes were less active.

Some soils on the ridgetops, such as Seaton soils, have formed entirely in loess. In Blackhammer and Southridge soils, the surface and subsurface layers and the upper part of the subsoil formed in loess. The lower part of the subsoil formed in the pedisediment formed on the preglacial landscape.

The soil layers formed in loess are considered young in age. Soils formed in loess have a very high capacity to store water for plants and are rich in nutrients. They formed in a climate that has varied somewhat during their formation. During the early stages of soil formation, the climate was cold because of the proximity to glacial ice to the west, north, and east. The early vegetation consisted of conifers followed briefly by oaks. These species were short lived following the retreat of glacial ice northward. The ensuing climate was warmer and drier and caused prairie plants to migrate eastward (*4*).

Processes of soil formation in loess were similar to those that formed in the limestone bedrock and the erosional sediment. The fine grained particles in loess provided large surface areas for weathering processes to act upon. Soil development, therefore, proceeded at a rapid rate. Studies in Iowa indicate that a fully developed soil can form in 1,000 years (*5*). The loess has been leached to a depth of 6 to 8 feet or more in most places. Leaching is greater on summits where infiltration of water is greater and, therefore, a relatively larger volume of water passes through the soil.

In most places the loess soils formed in an environment where air could freely enter the soil and provide oxygen. The oxygen along with water combined with iron. The original parent material, a light olive brown or olive silt loam, has been oxidized to dark yellowish brown to a depth of 3 or 4 feet. Here, as on soils formed from bedrock, iron compounds leave behind minerals that are weakened and easily altered. Some of the minerals are transformed into clays.

Many of the soils in Houston County formed at least partly under tall prairie grass, such as big bluestem,

although at the time of settlement, woodland covered most of the county (*7*). Prairie plants produce and accumulate large amounts of organic matter. The plants grew, died, and decayed over hundreds of years. Organic matter has enriched the upper 10 to 16 inches of the soil surface in places, mainly on the summits of the broader ridgetops. Examples of this process are the thick, darkened A horizon and the strongly oxidized B horizon in the Port Byron soils. These soils occur where prairie has persisted into recent time.

About 4,000 to 5,000 years ago, the climate became cooler and more moist. The big woods spread westward once again. Aspect and topography were also factors in the expansion of the woodland. Timber probably became established first on the sheltered north-facing foot slopes. Trees may have even persisted here during the eastward migration of the prairie. From these sheltered sites, timber spread out onto the silty and clayey terraces and upward onto the ridgetops. Except for small areas of prairie in the southwestern part of the county and sandy patches along the Root River, the county at the time of settlement was covered with woodland.

The character of the soils encroached upon by woodland changed in response to processes generated by the timber. Forests produce little organic matter, most of which accumulates on the soil surface. This is in contrast to the prairie soils, which build up large amounts of organic matter and form a thick dark surface layer.

The organic matter produced by the decay of leaves, limbs, and trunks is more acid than that produced by prairie vegetation. The strong acids, formed by water percolating through the surface litter and into the soil, increased the mobility of clay, organic matter, and oxides and allowed them to be leached away or to accumulate in the subsoil. The dark surface soils that had previously formed under prairie in time became thinner. As clay and organic matter were removed, a thin bleached subsurface layer began to form just below the thinning surface soil. Clay and organic matter accumulated as thin waxy films on blocky peds in the subsoil and along cracks and pores formerly occupied by roots. A fully developed forest soil, of which Seaton and Southridge soils are examples, has a black or very dark brown surface layer 2 to 4 inches thick, an ashy, grayish subsurface layer that is low in clay and organic matter and is 5 to 10 inches thick, and a subsoil with structural development and clay and organic matter on blocky structural surfaces. Tillage has mixed the original surface layer and material from the upper part of the subsoil in many places. Many soils, such as the Mt. Carroll soils, reflect the influence of both prairie and woodland because woodland has not persisted long enough to alter the prairie soils completely.

Soils Formed in Colluvium on the Very Steep Side Slopes of Ridges

Soil forming processes in the colluvium weathered from limestone on the steep to very steep sides of ridges were similar to but less intense than those that formed the loess soils. Weathering was dominated by physical weathering, the freezing and thawing of bedrock, and the movement downslope by gravitation.

These soils are considered young for two reasons. Although the rocks from which the soils formed are old, the soils are young. The surface is constantly eroding. Cobbles and pebbles are produced by freezing and thawing in cracks and fissures. The smaller silty and sandy particles were produced by the cobbles and pebbles abrading as the material moved downslope. Small amounts of clay were formed by the chemical action of acid water acting upon the finer particles. Secondly, very rapid to rapid runoff has reduced the opportunity for the leaching of calcium and magnesium. On the very steep wooded slopes, carbonates are leached to a depth of less than 3 feet. The subsoil is weakly oxidized because of the lack of moisture that is related partly to the coarse texture of the parent materials and partly to the very rapid runoff.

Most of the very steep valley side slopes are presently wooded. Trees are a recent plant succession. Prairie grasses were evidently the dominant vegetative influence in the formation of the soils because the surface soil is thick and very dark brown, characteristic of soils formed under grasses. Lacrescent soils are dominant on these wooded sites.

Grasses persist in microclimate environments on west- and south-facing ridge slopes along the wider valleys. This microclimate is warmer and drier and supports a short grass prairie. This sparse vegetation with its shallow root system developed less organic matter, which was readily oxidized. Runoff is more rapid on the sparse soil cover. Carbonates are leached to a depth of a few inches in some places, and the subsoil is weakly oxidized to a depth of 10 to 20 inches. The Brodale soils are on these sites. Redcedars are recent competitors.

At the valley head and on the shoulder slopes, the soils formed in a thin layer of loess and erosional sediment overlying the colluvium. Here, the soil materials can store more water and trees become established earlier than on the steeper slopes below. The Lamoille soils are representative of the soil development.

Soils Formed in Alluvium

The alluvial soils of the flood plain formed mostly under grasses, although woodland covered much of the alluvial plains at the time of settlement. Soils formed in alluvium are recent. Many formed in an environment in

which the alluvium was saturated. Saturated conditions restrict the availability of oxygen needed to oxidize the subsoil to dark yellowish brown or brown colors. Saturated conditions reduce the iron, making it mobile in the soil and easily leached from the soil. This process, called gleying, is evidenced by the characteristic gray or olive gray colors in the subsoil and underlying material. In places the translocated iron accumulates in the underlying material as yellowish red or strong brown mottles or pipes. The lush growth of water-tolerant vegetation formed a black surface layer that accumulated to as much as 2 feet in thickness. Examples are Comfrey and Walford Variant soils.

Many soils on flood plains have a mantle of lighter colored alluvium of variable thickness that dates from the time of settlement. These materials are so recent that the soils have not had time to form distinct horizons. The Newalbin and Arenzville soils are examples.

Organic Soils

Where water table conditions are such that the soils are nearly always saturated, a lush growth of water-tolerant plants, such as reeds and sedges, is common. These conditions develop below terrace side slopes as springs or seeps. In places along the Root River, organic soils formed on sites where the water table is on or near the surface year round. This saturation excluded or restricted the intake of oxygen necessary to completely decay the vegetation. Where a significant portion of individual plant parts can be identified, the organic material is referred to as peat. Where decomposition has altered plants to such a degree that they cannot be identified, the soils are called muck. Muck typically contains a significant mineral content. In a few places organic soils have accumulated to a thickness of 6 feet or more.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for

significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A

fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface,

have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material,

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material

that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded and 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1957-74 at Caledonia, Minnesota]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	22.5	2.8	12.7	46	-31	0	.96	.32	1.46	3	8.2
February	28.3	7.2	17.8	47	-24	0	1.10	.26	1.76	3	8.8
March	39.9	19.3	29.6	69	-15	16	2.23	1.14	3.11	5	11.4
April	56.0	33.0	44.5	82	13	37	2.96	1.51	4.13	7	3.5
May	68.3	44.4	56.4	88	24	235	4.35	2.37	5.95	8	.0
June	77.5	53.8	65.7	92	37	471	4.33	2.67	5.81	7	.0
July	81.3	57.9	69.6	93	44	608	4.06	2.06	5.68	6	.0
August	79.7	56.0	67.9	92	40	555	3.76	1.69	5.44	6	.0
September	70.2	47.4	58.8	89	27	275	4.50	2.18	6.40	7	.0
October	60.2	38.1	49.2	82	18	106	2.46	1.21	3.47	5	.0
November	42.6	24.3	33.5	65	2	0	1.84	.65	2.79	4	4.0
December	28.2	11.2	19.7	57	-23	0	1.38	.65	1.97	4	8.0
Year	54.6	33.0	43.8	96	-32	2,303	33.93	27.62	39.91	65	43.9

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1957-74 at Caledonia, Minnesota]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 2	May 20	May 27
2 years in 10 later than--	April 27	May 14	May 21
5 years in 10 later than--	April 18	May 3	May 10
First freezing temperature in fall:			
1 year in 10 earlier than--	October 8	September 23	September 18
2 years in 10 earlier than--	October 14	September 29	September 22
5 years in 10 earlier than--	October 25	October 11	October 1

TABLE 3.--GROWING SEASON

[Recorded in the period 1957-74 at Caledonia, Minnesota]

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	164	131	119
8 years in 10	172	141	127
5 years in 10	189	160	143
2 years in 10	205	179	159
1 year in 10	213	189	167

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
8A	Sparta loamy sand, 0 to 6 percent slopes	480	0.1
11C	Sogn silt loam, 2 to 12 percent slopes	200	0.1
16	Arenzville silt loam	5,810	1.6
18	Comfrey silt loam, occasionally flooded	680	0.2
25	Becker sandy loam	580	0.2
27B	Dickinson sandy loam, 1 to 6 percent slopes	420	0.1
76A	Bertrand silt loam, 0 to 2 percent slopes	340	0.1
76B	Bertrand silt loam, 2 to 6 percent slopes	380	0.1
79B	Billett sandy loam, 1 to 6 percent slopes	350	0.1
79C	Billett sandy loam, 6 to 12 percent slopes	250	0.1
81F	Boone sand, rocky, 20 to 70 percent slopes	630	0.2
103A	Seaton silt loam, 1 to 3 percent slopes	680	0.2
103B	Seaton silt loam, 3 to 6 percent slopes	18,980	5.2
103C2	Seaton silt loam, 6 to 12 percent slopes, eroded	27,025	7.1
103D2	Seaton silt loam, 12 to 20 percent slopes, eroded	7,070	2.0
131B	Massbach silt loam, 3 to 6 percent slopes	320	0.1
131C	Massbach silt loam, 6 to 12 percent slopes	880	0.2
136	Madelia silt loam	580	0.2
143E2	Eleva loam, 20 to 30 percent slopes, eroded	320	0.1
143F	Eleva sandy loam, 30 to 45 percent slopes	1,050	0.3
177B	Gotham loamy sand, 2 to 10 percent slopes	280	0.1
194	Huntsville silt loam, occasionally flooded	1,300	0.4
216B	Lamont fine sandy loam, 1 to 6 percent slopes	400	0.1
244B	Lilah sandy loam, 2 to 6 percent slopes	200	0.1
250	Kennebec silt loam, occasionally flooded	850	0.2
273	Muscatine silt loam	240	0.1
283B	Plainfield sand, 0 to 6 percent slopes	560	0.2
283C	Plainfield sand, 6 to 12 percent slopes	550	0.2
283D	Plainfield sand, 12 to 25 percent slopes	550	0.2
283F	Plainfield sand, 25 to 50 percent slopes	3,850	1.0
285A	Port Byron silt loam, 1 to 3 percent slopes	3,640	1.0
285B	Port Byron silt loam, 3 to 6 percent slopes	8,870	2.5
285C	Port Byron silt loam, 6 to 12 percent slopes	1,840	0.5
298	Richwood silt loam	330	0.1
301B	Lindstrom silt loam, 1 to 6 percent slopes	1,500	0.4
301C	Lindstrom silt loam, 6 to 12 percent slopes	1,650	0.5
312B	Shullsburg silt loam, 1 to 6 percent slopes	200	0.1
312C	Shullsburg silt loam, 6 to 12 percent slopes	310	0.1
322D2	Timula silt loam, 12 to 20 percent slopes, eroded	350	0.1
322E	Timula silt loam, 20 to 40 percent slopes	1,640	0.5
388C2	Seaton silt loam, valleys, 6 to 12 percent slopes, eroded	2,520	0.7
388D2	Seaton silt loam, valleys, 12 to 20 percent slopes, eroded	5,710	1.6
388E	Seaton loam, valleys, 20 to 30 percent slopes	9,440	2.6
388F	Seaton loam, valleys, 30 to 45 percent slopes	4,420	1.2
401B	Mt. Carroll silt loam, 3 to 6 percent slopes	7,870	2.2
401C	Mt. Carroll silt loam, 6 to 12 percent slopes	14,720	4.0
401D	Mt. Carroll silt loam, 12 to 20 percent slopes	630	0.2
455A	Festina silt loam, 0 to 2 percent slopes	2,080	0.6
455B	Festina silt loam, 2 to 6 percent slopes	2,060	0.6
455C2	Festina silt loam, 6 to 12 percent slopes, eroded	740	0.2
457E	Lacrescent flaggy silt loam, 20 to 35 percent slopes	1,090	0.3
457G	Lacrescent cobbly silty clay loam, 45 to 70 percent slopes	30,930	8.3
463	Minneiska fine sandy loam, occasionally flooded	1,450	0.4
471	Root silt loam	360	0.1
476B	Frankville silt loam, 3 to 6 percent slopes	410	0.1
476C2	Frankville silt loam, 6 to 12 percent slopes, eroded	1,300	0.4
476D	Frankville silt loam, 12 to 20 percent slopes	930	0.3
477	Littleton silt loam	990	0.3
484D	Eyota sandy loam, 12 to 20 percent slopes	380	0.1
488G	Brodale cobbly fine sandy loam, rocky, 45 to 70 percent slopes	5,280	1.5
492B	Nasset silt loam, 3 to 6 percent slopes	480	0.1
492C	Nasset silt loam, 6 to 12 percent slopes	950	0.3
500C2	Edmund silt loam, 4 to 12 percent slopes, eroded	510	0.1
500D2	Edmund silt loam, 12 to 20 percent slopes, eroded	910	0.3
518	Kalmarville silty clay loam, occasionally flooded	660	0.2
522	Boots mucky peat	270	0.1
576	Newalbin silt loam	1,400	0.4
577	Newalbin silt loam, channeled	1,700	0.5
578	Newalbin silt loam, depressional	1,040	0.3
580B	Blackhammer-Southridge silt loams, 3 to 6 percent slopes	1,810	0.5
580C2	Blackhammer-Southridge silt loams, 6 to 12 percent slopes, eroded	12,010	3.2
580D2	Blackhammer-Southridge silt loams, 12 to 20 percent slopes, eroded	21,745	5.7

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
584F	Lamoille-Dorerton silt loams, 30 to 45 percent slopes	15,500	4.2
585C	Newhouse-Valton silt loams, 6 to 12 percent slopes	1,320	0.4
585D	Newhouse-Valton silt loams, 12 to 20 percent slopes	1,360	0.4
586C2	Nodine-Rollingstone silt loams, 4 to 12 percent slopes, eroded	2,820	0.8
586D2	Nodine-Rollingstone silt loams, 12 to 20 percent slopes, eroded	15,250	4.1
592E	Lamoille-Elbaville silt loams, 20 to 30 percent slopes	32,960	8.7
593F	Elbaville silt loam, 30 to 45 percent slopes	8,840	2.4
598B	Beavercreek-Arenzville complex, 1 to 12 percent slopes	7,780	2.2
599E2	Norden silt loam, 15 to 30 percent slopes, eroded	890	0.2
599F	Norden silt loam, 30 to 45 percent slopes	1,100	0.3
601D2	Council fine sandy loam, 12 to 20 percent slopes, eroded	220	0.1
601E	Council sandy loam, 20 to 30 percent slopes	1,060	0.3
604	Huntsville-Beavercreek silt loams, channeled	3,220	0.9
605D2	La Farge silt loam, 12 to 20 percent slopes, eroded	500	0.1
606	Shiloh silty clay, ponded	1,830	0.5
608	Rawles silt loam, occasionally flooded	2,240	0.6
879B	Newalbin-Palms complex, 2 to 8 percent slopes	340	0.1
1010	Riverwash	360	0.1
1013	Pits, quarries	110	*
1016	Udorthents, loamy	840	0.2
1812	Terril loam, sandy substratum	910	0.3
1822B	Abscota Variant sand, 2 to 6 percent slopes	360	0.1
1830	Eitzen silt loam, occasionally flooded	2,840	0.8
1838	Colo silt loam, overwash	700	0.2
1847	Kalmarville fine sandy loam, channeled	380	0.1
1856D	Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes	860	0.2
1856E	Plainfield loamy fine sand, loamy substratum, 25 to 50 percent slopes	640	0.2
1857B	Eitzen silt loam, 1 to 6 percent slopes, channeled	3,410	0.9
1858F	Timula-Lamont complex, 40 to 70 percent slopes	2,420	0.7
1860	Comfrey silty clay loam, channeled	5,410	1.5
1861B	Chaseburg silt loam, 2 to 6 percent slopes, channeled	3,150	0.9
1862	Zwingle Variant silty clay	670	0.2
1885	Abscota loamy sand, occasionally flooded	310	0.1
1886	Minneiska Variant loamy fine sand	790	0.2
1888	Moundprairie silty clay loam, occasionally flooded	2,280	0.6
1889	Moundprairie silty clay loam, depressional	1,210	0.3
1890	Walford silt loam	310	0.1
1893C	Beavercreek Variant silt loam, 3 to 8 percent slopes	460	0.1
1898F	Etter-Brodale complex, rocky, 25 to 50 percent slopes	2,510	0.7
1906D	Lindstrom loam, 12 to 20 percent slopes	570	0.2
	Water areas more than 40 acres	3,140	0.9
	Total	364,800	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass	Reed canarygrass
	Bu	Ton	Bu	Ton	AUM*	AUM*	AUM*
8A---------- Sparta	65	9.0	55	2.5	5.3	2.0	---
11C---------- Sogn	---	---	40	2.5	5.3	2.5	---
16---------- Arenzville	135	21.0	75	5.5	10.6	3.5	---
18---------- Comfrey	125	19.5	70	5.0	---	3.8	10.0
25---------- Becker	95	15.0	70	4.0	8.0	3.0	---
27B---------- Dickinson	90	14.0	65	3.5	7.2	2.7	---
76A---------- Bertrand	140	21.5	85	6.0	11.5	3.2	---
76B---------- Bertrand	135	21.0	85	6.0	11.5	3.2	---
79B---------- Billett	90	14.0	70	3.5	7.2	2.7	---
79C---------- Billett	80	12.5	65	3.3	6.7	2.5	---
81F---------- Boone	---	---	---	---	---	7.0	---
103A, 103B---------- Seaton	150	23.0	85	6.5	12.0	3.3	---
103C2---------- Seaton	140	21.5	80	6.0	11.5	3.0	---
103D2---------- Seaton	130	20.0	75	5.8	11.0	2.8	---
131B---------- Massbach	135	21.0	75	5.3	10.2	3.3	---
131C---------- Massbach	125	19.5	75	5.0	9.8	3.0	---
136---------- Madelia	120	---	80	4.5	6.5	---	5.5
143E2---------- Eleva	---	---	40	3.5	---	2.2	---
143F. Eleva							
177B---------- Gotham	75	12.0	60	3.3	6.7	2.0	---
194---------- Huntsville	106	---	60	4.1	6.8	---	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass	Reed canarygrass
	Bu	Ton	Bu	Ton	AUM*	AUM*	AUM*
216B---------- Lamont	110	17.0	80	4.8	9.0	2.8	---
244B---------- Lilah	43	---	34	1.5	2.5	1.1	---
250---------- Kennebec	135	21.0	70	4.5	9.0	3.8	---
273---------- Muscatine	165	25.0	80	6.5	12.0	3.8	---
283B, 283C---------- Plainfield	50	7.0	45	2.3	5.3	1.8	---
283D, 283F---------- Plainfield	---	---	40	2.0	4.9	1.5	---
285A, 285B---------- Port Byron	160	24.0	85	6.5	12.0	3.5	---
285C---------- Port Byron	150	23.0	80	6.0	11.4	3.3	---
298---------- Richwood	145	22.0	85	5.5	11.2	3.3	---
301B---------- Lindstrom	165	25.0	80	6.5	12.0	3.5	---
301C---------- Lindstrom	155	24.0	80	6.3	11.5	3.5	---
312B---------- Shullsburg	100	15.0	60	3.8	7.7	3.3	---
312C---------- Shullsburg	90	14.0	55	3.5	5.2	3.0	---
322D2---------- Timula	120	18.0	65	5.7	10.5	2.3	---
322E---------- Timula	---	---	---	---	---	1.7	---
388C2---------- Seaton	140	21.0	80	6.0	11.5	3.0	---
388D2---------- Seaton	130	20.0	75	5.8	11.0	2.7	---
388E---------- Seaton	---	---	---	3.6	6.0	---	---
388F---------- Seaton	---	---	---	2.7	4.5	---	---
401B---------- Mt. Carroll	155	24.0	85	6.5	12.0	3.5	---
401C---------- Mt. Carroll	145	22.0	80	6.0	11.2	---	---
401D---------- Mt. Carroll	135	21.0	75	5.8	11.2	3.0	---
455A---------- Festina	155	24.0	85	6.5	12.0	3.5	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass	Reed canarygrass
	Bu	Ton	Bu	Ton	AUM*	AUM*	AUM*
455B---------- Festina	155	24.0	85	6.5	12.0	3.5	---
455C2---------- Festina	145	22.0	85	6.0	11.2	3.3	---
457E---------- Lacrescent	---	---	---	---	---	2.0	---
457G. Lacrescent							
463---------- Minneiska	105	16.0	65	4.3	8.5	2.8	---
471---------- Root	---	---	---	---	---	1.3	6.5
476B---------- Frankville	95	15.0	70	4.3	8.5	2.8	---
476C2---------- Frankville	90	14.0	65	4.0	8.0	2.5	---
476D---------- Frankville	85	12.5	60	3.5	7.2	2.3	---
477---------- Littleton	165	25.0	80	6.5	12.0	3.5	---
484D---------- Eyota	110	17.0	70	4.8	9.5	2.5	---
488G---------- Brodale	---	---	---	---	---	0.6	---
492B---------- Nasset	130	20.0	85	5.5	10.6	3.3	---
492C---------- Nasset	120	18.0	80	5.3	10.2	3.0	---
500C2---------- Edmund	85	13.0	60	3.3	6.7	2.5	---
500D2---------- Edmund	75	11.0	55	3.0	6.2	2.3	---
518---------- Kalmarville	85	13.0	45	3.0	6.2	3.0	9.0
522---------- Boots	---	---	---	---	---	---	---
576---------- Newalbin	130	20.0	70	5.0	7.0	3.5	9.0
577---------- Newalbin	---	---	---	---	---	3.2	9.0
578---------- Newalbin	---	---	---	---	---	---	4.5
580B---------- Blackhammer-Southridge	125	19.0	80	5.3	10.2	3.3	---
580C2---------- Blackhammer-Southridge	115	17.0	75	5.0	9.8	3.0	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass	Reed canarygrass
	Bu	Ton	Bu	Ton	AUM*	AUM*	AUM*
580D2---------- Blackhammer-Southridge	105	16.0	70	4.8	9.5	2.8	---
584F. Lamoille-Dorerton							
585C---------- Newhouse-Valton	120	18.0	80	5.0	9.8	3.3	---
585D---------- Newhouse-Valton	110	17.0	75	4.8	9.5	3.0	---
586C2---------- Nodine-Rollingstone	100	15.0	65	4.3	8.5	2.5	---
586D2---------- Nodine-Rollingstone	90	14.0	60	3.8	7.5	2.3	---
592E---------- Lamoille-Elbaville	---	---	---	---	---	2.0	---
593F---------- Elbaville	---	---	---	---	---	2.5	---
598B---------- Beavercreek-Arenzville	---	---	---	---	---	1.5	---
599E2---------- Norden	---	---	---	3.3	6.3	2.0	---
599F. Norden							
601D2---------- Council	100	16.0	70	4.5	---	3.4	---
601E---------- Council	---	---	65	4.3	8.5	2.7	---
604---------- Huntsville-Beavercreek	---	---	---	---	---	2.5	---
605D2---------- La Farge	100	15.0	75	4.5	9.0	2.5	---
606---------- Shiloh	---	---	---	---	---	---	---
608---------- Rawles	135	21.0	75	5.0	9.8	2.0	---
879B. Newalbin-Palms							
1010**. Riverwash							
1013**. Pits							
1016. Udorthents							
1812---------- Terril	135	21.0	94	5.0	8.3	4.2	---
1822B---------- Abscota Variant	---	---	---	3.3	---	2.2	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass	Reed canarygrass
	Bu	Ton	Bu	Ton	AUM*	AUM*	AUM*
1830--- Eitzen	150	23.0	75	6.0	11.5	3.5	---
1838--- Colo	125	19.0	65	5.0	7.0	4.0	10.0
1847--- Kalmarville	---	---	---	---	---	2.5	---
1856D--- Plainfield	85	13.0	60	3.5	7.2	1.0	---
1856E. Plainfield							
1857B--- Eitzen	---	---	---	---	---	3.5	---
1858F. Timula-Lamont							
1860--- Comfrey	---	---	---	---	---	---	3.5
1861B--- Chaseburg	100	15.0	75	4.3	8.5	2.7	---
1862--- Zwingle Variant	75	12.0	45	2.8	5.7	3.3	9.0
1885--- Abscota	55	9.0	35	2.0	4.3	---	---
1886--- Minneiska Variant	90	14.0	60	3.0	6.2	2.5	---
1888--- Moundprairie	110	17.0	65	---	---	3.8	10.0
1889--- Moundprairie	---	---	---	---	---	---	4.5
1890--- Walford	145	22.5	75	6.0	11.2	3.5	10.0
1893C--- Beavercreek Variant	105	16.0	65	4.5	9.0	2.5	6.0
1898F. Etter-Brodale							
1906D--- Lindstrom	145	22.0	70	5.8	11.2	3.3	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
8A---------- Sparta	3s	Slight	Slight	Severe	Slight	Severe	Jack pine----------	57	Red pine, eastern white pine, jack pine.
							Northern red oak----	47	
							Red pine----------	---	
16---------- Arenzville	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak----	65	White oak, eastern white pine, northern red oak, black walnut, American basswood.
							Bur oak----------	---	
							Silver maple--------	---	
25---------- Becker	4o	Slight	Slight	Slight	Slight	Moderate	Eastern cottonwood--	80	Eastern cottonwood, northern red oak, eastern white pine, black walnut.
							American elm--------	55	
							Black ash----------	55	
76A, 76B---------- Bertrand	1o	Slight	Slight	Slight	Slight	Severe	Northern red oak----	70+	Eastern white pine, white ash, black walnut, sugar maple, northern red oak, American basswood.
							White ash----------	---	
							White oak----------	---	
							Bur oak----------	---	
79B, 79C---------- Billett	3o	Slight	Slight	Slight	Slight	Slight	Northern red oak----	60	Red pine, eastern white pine, northern red oak, white oak.
							Bur oak----------	---	
							Black oak----------	---	
							White oak----------	---	
							Northern pin oak----	---	
							Black cherry--------	---	
							Shagbark hickory----	---	
81F---------- Boone	4s	Severe	Severe	Severe	Slight	Slight	Northern pin oak----	44	Red pine, jack pine, Scotch pine.
							Jack pine----------	49	
							Black oak----------	---	
103A, 103B, 103C2-- Seaton	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak----	70	Northern red oak, eastern white pine, black walnut, white oak, white ash, American basswood.
103D2---------- Seaton	2r	Moderate	Moderate	Moderate	Slight	Moderate	Northern red oak----	70	Northern red oak, eastern white pine, black walnut, white oak, white ash, American basswood.
131B, 131C---------- Massbach	3o	Slight	Slight	Slight	Slight	Slight	White oak----------	70	White oak, black walnut, white ash, bur oak, eastern white pine, American basswood, northern red oak, sugar maple.
							Northern red oak----	---	

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
143E2-------------- Eleva	4r	Moderate	Moderate	Slight	Slight	Slight	Black oak---------- Jack pine---------- Northern pin oak---- Northern red oak----	45 --- --- ---	Jack pine, red pine.
143F-------------- Eleva	4r	Severe	Severe	Slight	Slight	Slight	Black oak---------- Jack pine---------- Northern pin oak---- Northern red oak----	45 --- --- ---	Jack pine, red pine.
177B-------------- Gotham	3s	Slight	Slight	Moderate	Slight	Moderate	Northern pin oak---- Jack pine---------- Red pine---------- Eastern white pine-- Bur oak----------	54 60 54 56 40	Red pine, jack pine, eastern white pine.
194--------------- Huntsville	1o	Slight	Slight	Slight	Slight	Moderate	Eastern cottonwood-- American sycamore--- Yellow-poplar------- Cherrybark oak------ Sweetgum---------- Green ash----------	110 --- 98 --- --- ---	Eastern cottonwood, black walnut, American sycamore, red maple, sugar maple, green ash, hackberry.
216B-------------- Lamont	3o	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- White oak----------	55 55	Eastern white pine, red pine, white oak, northern red oak.
250--------------- Kennebec	2o	Slight	Slight	Slight	Slight	Moderate	Black walnut-------- Bur oak---------- Hackberry---------- Green ash---------- Eastern cottonwood--	79 63 --- --- ---	Black walnut, hackberry, eastern cottonwood, sugar maple.
283B, 283C-------- Plainfield	3s	Slight	Slight	Moderate	Slight	Moderate	Red pine---------- Eastern white pine-- Jack pine---------- Northern pin oak----	55 --- --- ---	Red pine, eastern white pine, jack pine.
283D, 283F-------- Plainfield	3s	Moderate	Severe	Moderate	Slight	Moderate	Red pine---------- Eastern white pine-- Jack pine---------- Northern pin oak----	55 --- --- ---	Red pine, eastern white pine, jack pine.
322D2, 322E------- Timula	3r	Moderate	Moderate	Moderate	Slight	Slight	White oak---------- Northern red oak---- Green ash---------- Bur oak----------	70 --- --- ---	Eastern white pine, white oak, northern red oak.
388C2------------- Seaton	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- White oak---------- American basswood---	70 --- ---	Black walnut, white oak, northern red oak.
388D2, 388E------- Seaton	2r	Moderate	Moderate	Moderate	Slight	Moderate	Northern red oak---- White oak---------- American basswood---	70 --- ---	Black walnut, white oak, northern red oak.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
388F---------- Seaton	2r	Severe	Severe	Severe	Slight	Moderate	Northern red oak---- White oak---------- American basswood---	70 --- ---	Black walnut, white oak, northern red oak.
401B, 401C---------- Mt. Carroll	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- American basswood--- Sugar maple---------	70 --- ---	Black walnut, eastern white pine, white ash, northern red oak, sugar maple, American basswood.
401D---------- Mt. Carroll	2r	Moderate	Moderate	Moderate	Slight	Moderate	Northern red oak---- American basswood--- Sugar maple---------	70 --- ---	Black walnut, eastern white pine, white ash, northern red oak, sugar maple, American basswood.
455A, 455B, 455C2-- Festina	2o	Slight	Slight	Slight	Slight	Moderate	White oak---------- Northern red oak---- American elm-------- American basswood--- Butternut----------	65 65 --- --- ---	Eastern white pine, white oak, northern red oak, black walnut, sugar maple, American basswood.
457E---------- Lacrescent	3r	Moderate	Moderate	Slight	Moderate	Moderate	Northern red oak---- White oak---------- American basswood---	55 55 55	Eastern white pine, white oak, American basswood, northern red oak, white ash.
457G---------- Lacrescent	3r	Severe	Severe	Slight	Moderate	Moderate	Northern red oak---- White oak---------- American basswood---	55 55 55	Eastern white pine, white oak, American basswood, northern red oak, white ash.
463---------- Minneiska	2o	Slight	Slight	Slight	Slight	Severe	Eastern cottonwood--	100	Black walnut, green ash, white oak, silver maple.
471---------- Root	3w	Slight	Severe	Moderate	Moderate	Severe	Eastern cottonwood-- Silver maple-------- Green ash---------- American basswood---	90 60 60 80	Silver maple, eastern cottonwood, green ash, white spruce, American basswood.
476B, 476C2-------- Frankville	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- White oak----------	65 65	Eastern white pine, white oak, northern red oak, black walnut, white ash, sugar maple.
476D---------- Frankville	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak---- White oak----------	65 65	Eastern white pine, white oak, northern red oak, black walnut, white ash, sugar maple.
492C---------- Nasset	2o	Slight	Slight	Slight	Slight	Moderate	White oak---------- Northern red oak----	65 65	Eastern white pine, red pine, black walnut, sugar maple.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
500C2---------- Edmund	5d	Slight	Slight	Moderate	Moderate	Slight	Northern red oak---- White oak---------- Black oak---------- Shagbark hickory----	39 --- --- ---	Eastern white pine, jack pine, red pine.
500D2---------- Edmund	5d	Severe	Moderate	Moderate	Moderate	Slight	Northern red oak---- White oak---------- Black oak---------- Shagbark hickory----	39 --- --- ---	Eastern white pine, jack pine, red pine.
518---------- Kalmarville	3w	Slight	Severe	Moderate	Moderate	Severe	Eastern cottonwood-- Silver maple-------- Green ash---------- American basswood---	90 60 60 80	Silver maple, eastern cottonwood, green ash, white oak, white ash, hackberry.
522---------- Boots	3w	Slight	Severe	Severe	Severe	Severe			
580B*, 580C2*: Blackhammer--------	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- American basswood--- White oak---------- Shagbark hickory----	70 70 62 60	Northern red oak, American basswood, sugar maple, eastern white pine, white ash.
Southridge--------	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- American basswood--- White oak---------- American elm-------- Shagbark hickory----	70 70 62 70 60	Northern red oak, white oak, American basswood, eastern white pine, white ash, sugar maple.
580D2*: Blackhammer--------	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak---- American basswood--- White oak---------- Shagbark hickory----	70 70 62 60	Northern red oak, American basswood, sugar maple, white oak, eastern white pine, white ash, sugar maple.
Southridge--------	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak---- American basswood--- White oak---------- American elm-------- Shagbark hickory----	70 70 62 70 60	Northern red oak, American basswood, red pine, eastern white pine.
584F*: Lamoille----------	3c	Severe	Severe	Moderate	Moderate	Moderate	Northern red oak---- American basswood--- Green ash---------- White oak---------- Shagbark hickory---- Sugar maple---------	58 58 52 52 50 50	Northern red oak, white oak, American basswood, eastern white pine, white ash.

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
584F*:									
Dorerton	3f	Moderate	Severe	Moderate	Slight	Slight	Northern red oak	55	Northern red oak, eastern white pine, white oak.
							Eastern white pine	50	
							White oak	50	
							Bur oak	50	
							American basswood	55	
							Black cherry	50	
							Quaking aspen	60	
585C*:									
Newhouse	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak	70	Northern red oak, American basswood, sugar maple, eastern white pine, white oak, white ash.
							American basswood	70	
							White oak	62	
							Shagbark hickory	60	
Valton	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak	70	Eastern white pine, American basswood, sugar maple, white ash, northern red oak, white oak.
							Sugar maple	---	
							American basswood	---	
							Shagbark hickory	60	
585D*:									
Newhouse	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak	70	Northern red oak, American basswood, sugar maple, eastern white pine, white oak, white ash.
							American basswood	70	
							White oak	62	
							Shagbark hickory	60	
Valton	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak	70	Eastern white pine, white ash, sugar maple, white oak, American basswood, northern red oak.
							Sugar maple	---	
							American basswood	---	
							Shagbark hickory	60	
586C2*:									
Nodine	2o	Slight	Slight	Slight	Moderate	Moderate	Northern red oak	65	Northern red oak, white oak, American basswood, sugar maple, eastern white pine, white ash.
							White oak	60	
							Shagbark hickory	60	
							American basswood	70	
							Sugar maple	60	
Rollingstone	3c	Slight	Slight	Slight	Moderate	Moderate	Northern red oak	65	Northern red oak, American basswood, sugar maple, eastern white pine, white oak, white ash.
							White oak	60	
							Shagbark hickory	60	
							American basswood	70	
							Sugar maple	60	
586D2*:									
Nodine	2r	Moderate	Moderate	Moderate	Moderate	Moderate	Northern red oak	65	Northern red oak, American basswood, sugar maple, eastern white pine, white oak, white ash.
							White oak	60	
							Shagbark hickory	60	
							American basswood	70	
							Sugar maple	60	

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
586D2*:									
Rollingstone	3c	Moderate	Moderate	Moderate	Moderate	Moderate	Northern red oak	65	Northern red oak, American basswood, sugar maple, eastern white pine, white oak, white ash.
							White oak	60	
							Shagbark hickory	60	
							American basswood	70	
							Sugar maple	60	
592E*:									
Lamoille	3c	Moderate	Moderate	Moderate	Moderate	Moderate	Northern red oak	55	Northern red oak, white oak, American basswood, eastern white pine.
							American basswood	55	
							Green ash	52	
							White oak	52	
							Shagbark hickory	50	
							Sugar maple	50	
Elbaville	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak	65	Northern red oak, black walnut, eastern white pine, white oak, sugar maple, American basswood.
							White oak	60	
							American basswood	65	
							Sugar maple	65	
							Butternut	65	
							Black walnut	65	
							Paper birch	---	
593F---Elbaville	2r	Severe	Severe	Slight	Slight	Moderate	Northern red oak	65	Northern red oak, black walnut, eastern white pine, white oak, sugar maple, American basswood.
							White oak	60	
							American basswood	65	
							Sugar maple	65	
							Butternut	65	
							Black walnut	65	
							Paper birch	---	
598B*:									
Beavercreek	3f	Slight	Moderate	Slight	Slight	Moderate	Northern red oak	55	Northern red oak, white ash, white oak, eastern white pine, eastern cottonwood, hackberry.
							White oak	55	
							Eastern white pine	50	
							Butternut	55	
							Black walnut	55	
Arenzville	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak	65	White ash, eastern white pine, white oak, northern red oak, black walnut, American basswood, sugar maple.
							Bur oak	---	
							Silver maple	---	
599E2---Norden	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak	63	Red pine, eastern white pine, jack pine, white oak.
							Black oak	---	
							White oak	---	
							Sugar maple	---	
							Quaking aspen	---	
599F---Norden	2r	Severe	Severe	Slight	Slight	Moderate	Northern red oak	63	Red pine, eastern white pine, jack pine, white oak.
							Black oak	---	
							White oak	---	
							Sugar maple	---	
							Quaking aspen	---	

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
601D2, 601E-------- Council	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak---- Sugar maple--------- American basswood--- Paper birch--------- Quaking aspen--------	70 --- --- --- ---	White oak, eastern white pine, sugar maple, black walnut, northern red oak, American basswood.
604*: Huntsville--------	1o	Slight	Slight	Slight	Slight	Moderate	Eastern cottonwood-- American sycamore--- Yellow-poplar------- Green ash----------	110 --- 98 ---	Eastern cottonwood, black walnut, red maple, sugar, maple, green ash, hackberry.
Beavercreek--------	3f	Slight	Moderate	Slight	Slight	Moderate	Northern red oak---- White oak---------- Eastern white pine-- Butternut---------- Black walnut--------	55 55 50 55 55	Northern red oak, white oak, eastern white pine, white ash, hackberry, eastern cottonwood.
605D2-------------- La Farge	2r	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak---- Black oak---------- White oak---------- Shagbark hickory---- American basswood---	65 --- --- --- ---	Eastern white pine, red pine, white oak, northern red oak.
879B*: Newalbin.									
Palms--------------	3w	Slight	Severe	Severe	Severe	Severe	Red maple---------- Silver maple-------- White ash---------- Quaking aspen------- Northern white-cedar Black ash----------	55 --- --- --- --- ---	
1822B-------------- Abscota Variant	2s	Slight	Slight	Moderate	Slight	Moderate		---	Red pine, eastern white pine, eastern cottonwood, green ash, blue spruce.
1847--------------- Kalmarville	3w	Slight	Severe	Moderate	Moderate	Severe	Eastern cottonwood-- Silver maple-------- Green ash---------- American basswood---	90 60 60 80	Silver maple, eastern cottonwood, green ash, American basswood.
1856D, 1856E------- Plainfield	3s	Moderate	Severe	Moderate	Slight	Moderate	Red pine---------- Eastern white pine-- Jack pine---------- Northern pin oak----	55 --- --- ---	Red pine, eastern white pine, jack pine.
1858F*: Timula----------	2r	Severe	Severe	Severe	Slight	Slight	White oak---------- Northern red oak---- Green ash---------- Bur oak----------	70 --- --- ---	Eastern white pine, white oak, northern red oak.

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
1858F*: Lamont	3o	Slight	Slight	Slight	Slight	Moderate	Northern red oak White oak	60 60	Eastern white pine, red pine, white oak, northern red oak.
1861B Chaseburg	2o	Slight	Slight	Slight	Slight	Moderate	American elm Green ash Eastern cottonwood Boxelder	60 --- --- ---	Red pine, eastern white pine, eastern cottonwood.
1862 Zwingle Variant	3w	Slight	Severe	Severe	Severe	Severe	Eastern cottonwood Silver maple	90 80	Eastern cottonwood, silver maple, black ash.
1885 Abscota	2s	Slight	Slight	Moderate	Slight	Moderate	Northern red oak White ash Silver maple Eastern cottonwood American sycamore	66 --- --- --- ---	Eastern cottonwood, eastern white pine, American sycamore.
1886 Minneiska Variant	2o	Slight	Slight	Moderate	Slight	Moderate	American elm Eastern cottonwood Silver maple	60 90 ---	Green ash, black walnut, sugar maple, eastern white pine.
1888 Moundprairie	3w	Slight	Slight	Moderate	Moderate	Moderate	Eastern cottonwood Green ash	86 50	Eastern cottonwood, silver maple, black ash, red maple.
1890 Walford	2w	Slight	Severe	Moderate	Slight	Moderate	White oak Northern red oak Bur oak	70 70 ---	Eastern white pine, black walnut, white ash, sugar maple, northern red oak.
1893C Beavercreek Variant	2o	Slight	Slight	Slight	Slight	Moderate	Northern red oak White oak Eastern white pine Black walnut	60 60 55 60	Northern red oak, white oak, black walnut, eastern white pine, white ash, American basswood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
8A Sparta	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
11C Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
16 Arenzville	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
18 Comfrey	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
25 Becker	Severe: flooding.	Slight	Slight	Slight	Slight.
27B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
76A Bertrand	Slight	Slight	Slight	Slight	Slight.
76B Bertrand	Slight	Slight	Moderate: slope.	Slight	Slight.
79B Billett	Slight	Slight	Moderate: slope.	Slight	Slight.
79C Billett	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
81F Boone	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.	Severe: droughty, slope.
103A, 103B Seaton	Slight	Slight	Moderate: slope.	Slight	Slight.
103C2 Seaton	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
103D2 Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
131B Massbach	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
131C Massbach	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
136 Madelia	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
143E2, 143F Eleva	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
177B Gotham	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
194 Huntsville	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
216B---------- Lamont	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
244B---------- Lilah	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: droughty.
250---------- Kennebec	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
273---------- Muscatine	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight----------	Slight.
283B---------- Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
283C---------- Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
283D---------- Plainfield	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty, slope.
283F---------- Plainfield	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: droughty, slope.
285A, 285B---------- Port Byron	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
285C---------- Port Byron	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
298---------- Richwood	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
301B---------- Lindstrom	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
301C---------- Lindstrom	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
312B---------- Shullsburg	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, thin layer.
312C---------- Shullsburg	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope, thin layer.
322D2---------- Timula	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
322E---------- Timula	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
388C2---------- Seaton	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
388D2---------- Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
388E, 388F---------- Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
401B Mt. Carroll	Slight	Slight	Moderate: slope.	Slight	Slight.
401C Mt. Carroll	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
401D Mt. Carroll	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
455A Festina	Slight	Slight	Slight	Slight	Slight.
455B Festina	Slight	Slight	Moderate: slope.	Slight	Slight.
455C2 Festina	Slight	Slight	Severe: slope.	Slight	Slight.
457E Lacrescent	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Moderate: large stones, slope.	Severe: slope.
457G Lacrescent	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: slope.
463 Minneiska	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
471 Root	Severe: flooding, wetness.	Severe: wetness.	Severe: small stones, wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
476B Frankville	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Moderate: thin layer.
476C2 Frankville	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope, thin layer.
476D Frankville	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
477 Littleton	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
484D Eyota	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
488G Brodale	Severe: slope, small stones.	Severe: slope, small stones.	Severe: large stones, slope, small stones.	Severe: slope, small stones.	Severe: small stones, droughty, slope.
492B Nasset	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
492C Nasset	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
500C2 Edmund	Slight	Slight	Severe: slope.	Severe: erodes easily.	Severe: thin layer.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
500D2---------- Edmund	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope, thin layer.
518---------- Kalmarville	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
522---------- Boots	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
576, 577---------- Newalbin	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
578---------- Newalbin	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
580B*: Blackhammer----------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
Southridge----------	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
580C2*: Blackhammer----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Southridge----------	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
580D2*: Blackhammer----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Southridge----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
584F*: Lamoille----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
Dorerton----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
585C*: Newhouse----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Valton----------	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
585D*: Newhouse----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Valton----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
586C2*:					
Nodine	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Rollingstone	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
586D2*:					
Nodine	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Rollingstone	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
592E*:					
Lamoille	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
Elbaville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
593F---------- Elbaville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
598B*:					
Beavercreek	Severe: flooding.	Slight----------	Severe: slope, small stones.	Severe: erodes easily.	Moderate: flooding.
Arenzville	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
599E2---------- Norden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
599F---------- Norden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
601D2---------- Council	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
601E---------- Council	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
604*:					
Huntsville	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
Beavercreek	Severe: flooding.	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty, flooding.
605D2---------- La Farge	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
606---------- Shiloh	Severe: flooding, ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding, flooding.	Severe: ponding, too clayey.	Severe: ponding, flooding, too clayey.
608---------- Rawles	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
879B*:					
Newalbin	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Palms	Severe: ponding, excess humus, flooding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1010*. Riverwash					
1013*. Pits					
1016. Udorthents					
1812 Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
1822B Abscota Variant	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding, too sandy.
1830 Eitzen	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
1838 Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
1847 Kalmarville	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
1856D Plainfield	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1856E Plainfield	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1857B Eitzen	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
1858F*:					
Timula	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
Lamont	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1860 Comfrey	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness, flooding.
1861B Chaseburg	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
1862 Zwingle Variant	Severe: percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1885---------- Abscota	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding, droughty.
1886. Minneiska Variant					
1888---------- Moundprairie	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
1889---------- Moundprairie	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1890---------- Walford	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1893C---------- Beavercreek Variant	Severe: flooding.	Moderate: small stones.	Severe: small stones.	Slight----------	Moderate: small stones, large stones, flooding.
1898F*: Etter---------- Brodale----------	Severe: slope. Severe: slope, small stones.	Severe: slope. Severe: slope, small stones.	Severe: slope. Severe: large stones, slope, small stones.	Severe: slope. Severe: slope, small stones.	Severe: slope. Severe: small stones, droughty, slope.
1906D---------- Lindstrom	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
8A---------- Sparta	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
11C---------- Sogn	Very poor.	Very poor.	Poor	---	---	Very poor.	Very poor.	Very poor.	---	Very poor.
16---------- Arenzville	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
18---------- Comfrey	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
25---------- Becker	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Good.
27B---------- Dickinson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
76A, 76B---------- Bertrand	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
79B---------- Billett	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
79C---------- Billett	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
81F---------- Boone	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
103A, 103B---------- Seaton	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
103C2---------- Seaton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
103D2---------- Seaton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
131B---------- Massbach	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
131C---------- Massbach	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
136---------- Madelia	Good	Good	Good	Good	Fair	Good	Good	Good	Fair	Good.
143E2, 143F---------- Eleva	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
177B---------- Gotham	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
194---------- Huntsville	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
216B---------- Lamont	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
244B---------- Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
250---------- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
273---------- Muscatine	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
283B---------- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
283C, 283D, 283F--- Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
285A, 285B--------- Port Byron	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
285C---------- Port Byron	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
298---------- Richwood	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
301B---------- Lindstrom	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
301C---------- Lindstrom	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
312B---------- Shullsburg	Good	Good	Fair	Fair	Good	Good	Fair	Good	Fair	Fair.
312C---------- Shullsburg	Fair	Good	Fair	Fair	Good	Poor	Very poor.	Fair	Fair	Very poor.
322D2, 322E-------- Timula	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
388C2---------- Seaton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
388D2---------- Seaton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
388E, 388F--------- Seaton	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
401B---------- Mt. Carroll	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
401C---------- Mt. Carroll	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
401D---------- Mt. Carroll	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
455A, 455B, 455C2-- Festina	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
457E, 457G--------- Lacrescent	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
463---------- Minneiska	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
471---------- Root	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
476B---------- Frankville	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
476C2--- Frankville	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
476D--- Frankville	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
477--- Littleton	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
484D--- Eyota	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
488G--- Brodale	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.
492B, 492C--- Nasset	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
500C2--- Edmund	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
500D2--- Edmund	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
518--- Kalmarville	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
522--- Boots	Good	Good	Poor	Good	Poor	Good	Good	Good	Good	Good.
576--- Newalbin	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
577--- Newalbin	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
578--- Newalbin	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
580B*:										
Blackhammer	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Southridge	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
580C2*:										
Blackhammer	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Southridge	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
580D2*:										
Blackhammer	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Southridge	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
584F*:										
Lamoille	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Fair	Very poor.
Dorerton	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
585C*:										
Newhouse	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Valton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
585D*:										
Newhouse	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Valton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
586C2*:										
Nodine	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Rollingstone	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
586D2*:										
Nodine	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Rollingstone	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
592E*:										
Lamoille	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Elbaville	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
593F---- Elbaville	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
598B*:										
Beavercreek	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Fair	Very poor.
Arenzville	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
599E2---- Norden	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
599F---- Norden	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
601D2---- Council	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
601E---- Council	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
604*:										
Huntsville	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Beavercreek	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Fair	Very poor.
605D2---- La Farge	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
606---------- Shiloh	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
608---------- Rawles	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
879B*: Newalbin----------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Palms----------	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
1010*. Riverwash										
1013*. Pits										
1016. Udorthents										
1812---------- Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
1822B---------- Abscota Variant	Fair	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
1830---------- Eitzen	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
1838---------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
1847---------- Kalmarville	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
1856D, 1856E------- Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
1857B---------- Eitzen	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
1858F*: Timula----------	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.
Lamont----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
1860---------- Comfrey	Poor	Poor	Fair	Very poor.	Very poor.	Good	Good	Poor	Poor	Good.
1861B---------- Chaseburg	Poor	Good	Good	Good	Fair	Poor	Poor	Fair	Good	Poor.
1862---------- Zwingle Variant	Fair	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair.
1885---------- Abscota	Poor	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
1886---------- Minneiska Variant	Good	Good	Good	Good	Good	Poor	Poor	Good	Fair	Poor.
1888---------- Moundprairie	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1889--Moundprairie	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
1890--Walford	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
1893C--Beavercreek Variant	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1898F*: Etter.										
Brodale	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.
1906D--Lindstrom	Poor	Fair	Good	Good	Good	Poor	Poor	Good	Good	Poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
8A---------- Sparta	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
11C---------- Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
16---------- Arenzville	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Moderate: flooding.
18---------- Comfrey	Severe: wetness, excess humus.	Severe: flooding, wetness, low strength.	Severe: flooding, wetness.	Severe: flooding, wetness, low strength.	Severe: low strength, wetness, flooding.	Severe: wetness.
25---------- Becker	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
27B---------- Dickinson	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
76A---------- Bertrand	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
76B---------- Bertrand	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
79B---------- Billett	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
79C---------- Billett	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
81F---------- Boone	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
103A---------- Seaton	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength, frost action.	Slight.
103B---------- Seaton	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength, frost action.	Slight.
103C2---------- Seaton	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
103D2---------- Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
131B---------- Massbach	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
131C---------- Massbach	Moderate: too clayey, wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
136--- Madelia	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
143E2, 143F--- Eleva	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
177B--- Gotham	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Moderate: droughty.
194--- Huntsville	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
216B--- Lamont	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Moderate: frost action.	Slight.
244B--- Lilah	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Moderate: droughty.
250--- Kennebec	Severe: wetness, flooding.	Severe: flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
273--- Muscatine	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
283B--- Plainfield	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Slight---	Severe: droughty.
283C--- Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
283D, 283F--- Plainfield	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
285A--- Port Byron	Slight---	Slight---	Slight---	Slight---	Severe: low strength, frost action.	Slight.
285B--- Port Byron	Slight---	Slight---	Slight---	Moderate: slope.	Severe: low strength, frost action.	Slight.
285C--- Port Byron	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
298--- Richwood	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action.	Slight.
301B--- Lindstrom	Slight---	Slight---	Slight---	Slight---	Severe: frost action.	Slight.
301C--- Lindstrom	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
312B--- Shullsburg	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness, thin layer.
312C--- Shullsburg	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness, slope, thin layer.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
322D2, 322E---- Timula	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
388C2---- Seaton	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
388D2, 388E, 388F- Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
401B---- Mt. Carroll	Slight----	Slight----	Slight----	Moderate: slope.	Severe: low strength, frost action.	Slight.
401C---- Mt. Carroll	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
401D---- Mt. Carroll	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
455A---- Festina	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
455B---- Festina	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
455C2---- Festina	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Slight.
457E, 457G---- Lacrescent	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
463---- Minneiska	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
471---- Root	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
476B---- Frankville	Moderate: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength, frost action.	Moderate: thin layer.
476C2---- Frankville	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope, thin layer.
476D---- Frankville	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
477---- Littleton	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
484D---- Eyota	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
488G---------- Brodale	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.
492B---------- Nasset	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
492C---------- Nasset	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
500C2---------- Edmund	Moderate: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Severe: thin layer.
500D2---------- Edmund	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, thin layer.
518---------- Kalmarville	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness.
522---------- Boots	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: ponding, flooding, frost action.	Severe: ponding, excess humus.
576, 577---------- Newalbin	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: wetness, flooding.
578---------- Newalbin	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding.
580B*: Blackhammer------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: frost action.	Slight.
Southridge-------	Moderate: too clayey.	Slight---------	Moderate: shrink-swell.	Moderate: slope.	Severe: frost action.	Slight.
580C2*: Blackhammer------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action.	Moderate: slope.
Southridge-------	Moderate: too clayey, slope.	Moderate: slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action.	Moderate: slope.
580D2*: Blackhammer------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
Southridge-------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
584F*:						
Lamoille	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Dorerton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
585C*:						
Newhouse	Moderate: slope.	Moderate: slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Valton	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, frost action.	Moderate: slope.
585D*:						
Newhouse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
Valton	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, frost action.	Severe: slope.
586C2*:						
Nodine	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: slope.
Rollingstone	Moderate: too clayey, large stones, slope.	Moderate: shrink-swell, slope, large stones.	Moderate: slope, shrink-swell, large stones.	Severe: slope.	Severe: low strength.	Moderate: slope.
586D2*:						
Nodine	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rollingstone	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
592E*:						
Lamoille	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Elbaville	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
593F---------- Elbaville	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
598B*:						
Beavercreek	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Arenzville	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Moderate: flooding.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
599E2, 599F---- Norden	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
601D2, 601E---- Council	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
604*: Huntsville----	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
Beavercreek----	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
605D2---- La Farge	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
606---- Shiloh	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding, too clayey.
608---- Rawles	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
879B*: Newalbin----	Severe: excess humus, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, low strength.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness.
Palms----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1010*. Riverwash						
1013*. Pits						
1016. Udorthents						
1812---- Terril	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: low strength, frost action, flooding.	Slight.
1822B---- Abscota Variant	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding, too sandy.
1830---- Eitzen	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
1838---- Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1847--------- Kalmarville	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
1856D, 1856E------ Plainfield	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1857B--------- Eitzen	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
1858F*: Timula----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
Lamont----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1860--------- Comfrey	Severe: wetness, excess humus.	Severe: flooding, wetness, low strength.	Severe: flooding, wetness.	Severe: flooding, wetness, low strength.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
1861B--------- Chaseburg	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Severe: flooding.
1862--------- Zwingle Variant	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
1885--------- Abscota	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, droughty.
1886--------- Minneiska Variant	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
1888--------- Moundprairie	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
1889--------- Moundprairie	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding.
1890--------- Walford	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, low strength.	Moderate: wetness.
1893C--------- Beavercreek Variant	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: small stones, large stones, flooding.
1898F*: Etter----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1898F*: Brodale	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.
1906D---------- Lindstrom	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
8A Sparta	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
11C Sogn	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
16 Arenzville	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, wetness.	Poor: too sandy.
18 Comfrey	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
25 Becker	Severe: poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
27B Dickinson	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
76A, 76B Bertrand	Slight	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey, thin layer.
79B Billett	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
79C Billett	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.
81F Boone	Severe: depth to rock, poor filter, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, seepage, too sandy.
103A, 103B Seaton	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
103C2 Seaton	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
103D2 Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
131B Massbach	Severe: wetness, percs slowly.	Severe: wetness.	Severe: depth to rock.	Moderate: depth to rock.	Poor: thin layer.
131C Massbach	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: depth to rock.	Moderate: depth to rock, slope.	Poor: thin layer.
136 Madelia	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
143E2, 143F--------- Eleva	Severe: depth to rock, slope.	Severe: slope, seepage, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: slope, seepage, depth to rock.	Poor: slope, area reclaim.
177B---------- Gotham	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
194---------- Huntsville	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
216B---------- Lamont	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
244B---------- Lilah	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
250---------- Kennebec	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
273---------- Muscatine	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
283B---------- Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
283C---------- Plainfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
283D, 283F---------- Plainfield	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
285A, 285B---------- Port Byron	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
285C---------- Port Byron	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
298---------- Richwood	Slight----------	Severe: seepage.	Severe: seepage.	Slight----------	Fair: too clayey, thin layer.
301B---------- Lindstrom	Slight----------	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
301C---------- Lindstrom	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
312B---------- Shullsburg	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: area reclaim, too clayey, hard to pack.
312C---------- Shullsburg	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: area reclaim, too clayey, hard to pack.
322D2, 322E--------- Timula	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
388C2---------- Seaton	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
388D2, 388E, 388F--- Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
401B---------- Mt. Carroll	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
401C---------- Mt. Carroll	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
401D---------- Mt. Carroll	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
455A---------- Festina	Slight----------	Moderate: seepage.	Severe: seepage.	Slight----------	Fair: too clayey.
455B---------- Festina	Slight----------	Moderate: slope, seepage.	Severe: seepage.	Slight----------	Fair: too clayey.
455C2---------- Festina	Slight----------	Severe: slope.	Severe: seepage.	Slight----------	Fair: too clayey.
457E, 457G---------- Lacrescent	Severe: slope.	Severe: seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: large stones, slope.
463---------- Minneiska	Severe: flooding, wetness.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Fair: wetness.
471---------- Root	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, thin layer.
476B---------- Frankville	Moderate: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Fair: area reclaim.
476C2---------- Frankville	Moderate: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: depth to rock.	Fair: area reclaim.
476D---------- Frankville	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
477---------- Littleton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
484D---------- Eyota	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
488G---------- Brodale	Severe: slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope.	Poor: small stones, slope.
492B---------- Nasset	Moderate: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: depth to rock.	Poor: thin layer.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
492C---------- Nasset	Moderate: depth to rock, slope.	Severe: slope.	Severe: slope.	Moderate: depth to rock,	Poor: thin layer.
500C2---------- Edmund	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
500D2---------- Edmund	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
518---------- Kalmarville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
522---------- Boots	Severe: flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
576, 577---------- Newalbin	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
578---------- Newalbin	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
580B*:					
Blackhammer--------	Slight----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey, small stones.
Southridge---------	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
580C2*:					
Blackhammer--------	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
Southridge---------	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
580D2*:					
Blackhammer--------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Southridge---------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
584F*:					
Lamoille----------	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
584F*: Dorerton	Severe: slope.	Severe: seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
585C*: Newhouse	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Poor: small stones.
Valton	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
585D*: Newhouse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
Valton	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
586C2*: Nodine	Moderate: percs slowly, slope.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, large stones.
Rollingstone	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack, small stones.
586D2*: Nodine	Severe: slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, large stones, slope.
Rollingstone	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, small stones.
592E*: Lamoille	Severe: percs slowly, slope, depth to rock.	Severe: seepage, slope.	Severe: seepage, slope, large stones, depth to rock.	Severe: seepage, slope.	Poor: small stones, slope.
Elbaville	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: large stones, too sandy, seepage.
593F: Elbaville	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: large stones, too sandy, seepage.
598B*: Beavercreek	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: too sandy, large stones.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
598B*: Arenzville	Severe: flooding.	Severe: flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: too sandy.
599E2, 599F: Norden	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
601D2, 601E: Council	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
604*: Huntsville	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Beavercreek	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: too sandy, large stones.
605D2: La Farge	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
606: Shiloh	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
608: Rawles	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
879B*: Newalbin	Severe: flooding, wetness, percs slowly.	Severe: flooding, excess humus, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
Palms	Severe: subsides, ponding, flooding.	Severe: seepage, excess humus, ponding, flooding.	Severe: ponding, excess humus, flooding.	Severe: ponding, seepage, flooding.	Poor: ponding, excess humus.
1010*. Riverwash					
1013*. Pits					
1016. Udorthents					
1812: Terril	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
1822B: Abscota Variant	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
1830: Eitzen	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
1838: Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1847---------- Kalmarville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
1856D, 1856E-------- Plainfield	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
1857B---------- Eitzen	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
1858F*: Timula----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Lamont----------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
1860---------- Comfrey	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
1861B---------- Chaseburg	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
1862---------- Zwingle Variant	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
1885---------- Abscota	Severe: flooding, wetness, poor filter.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too sandy, seepage.
1886---------- Minneiska Variant	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
1888---------- Moundprairie	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
1889---------- Moundprairie	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
1890---------- Walford	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1893C---------- Beavercreek Variant	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Poor: small stones.
1898F*: Etter----------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1898F*: Brodale	Severe: slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope.	Poor: small stones, slope.
1906D---------- Lindstrom	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
8A Sparta	Good	Probable	Improbable: too sandy.	Fair: too sandy.
11C Sogn	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
16 Arenzville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
18 Comfrey	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
25 Becker	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim, thin layer.
27B Dickinson	Good	Probable	Improbable: too sandy.	Good.
76A, 76B Bertrand	Good	Probable	Improbable: too sandy.	Good.
79B Billett	Good	Probable	Probable	Fair: small stones.
79C Billett	Good	Probable	Probable	Fair: small stones, slope.
81F Boone	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
103A, 103B Seaton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
103C2 Seaton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
103D2 Seaton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
131B Massbach	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
131C Massbach	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
136 Madelia	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
143E2, 143F Eleva	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: excess fines.	Poor: slope.
177B Gotham	Good	Probable	Improbable: too sandy.	Poor: thin layer.
194 Huntsville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
216B---------- Lamont	Good----------	Probable----------	Improbable: too sandy.	Good.
244B---------- Lilah	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
250---------- Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
273---------- Muscatine	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
283B, 283C---------- Plainfield	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
283D---------- Plainfield	Fair: slope.	Probable----------	Improbable: too sandy.	Poor: too sandy, slope.
283F---------- Plainfield	Poor: slope.	Probable----------	Improbable: too sandy.	Poor: too sandy, slope.
285A, 285B---------- Port Byron	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
285C---------- Port Byron	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
298---------- Richwood	Good----------	Probable----------	Improbable: too sandy.	Good.
301B---------- Lindstrom	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
301C---------- Lindstrom	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
312B---------- Shullsburg	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
312C---------- Shullsburg	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, slope.
322D2---------- Timula	Fair: slope, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
322E---------- Timula	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
388C2---------- Seaton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
388D2---------- Seaton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
388E, 388F---------- Seaton	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
401B---------- Mt. Carroll	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
401C---------- Mt. Carroll	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
401D---------- Mt. Carroll	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
455A, 455B, 455C2----- Festina	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
457E---------- Lacrescent	Fair: area reclaim, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim, slope.
457G---------- Lacrescent	Poor: slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim, slope.
463---------- Minneiska	Good----------	Probable----------	Improbable: too sandy.	Good.
471---------- Root	Poor: wetness.	Improbable: large stones.	Improbable: large stones.	Poor: wetness, small stones, area reclaim.
476B---------- Frankville	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
476C2---------- Frankville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
476D---------- Frankville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
477---------- Littleton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
484D---------- Eyota	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
488G---------- Brodale	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
492B---------- Nasset	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
492C---------- Nasset	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, slope.
500C2---------- Edmund	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
500D2---------- Edmund	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
518---------- Kalmarville	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: wetness.
522---------- Boots	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
576, 577---------- Newalbin	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
578---------- Newalbin	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
580B*:				
Blackhammer----------	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Southridge----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
580C2*:				
Blackhammer----------	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Southridge----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim, slope.
580D2*:				
Blackhammer----------	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Southridge----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
584F*:				
Lamoille----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Dorerton----------	Poor: slope.	Probable----------	Probable----------	Poor: small stones, area reclaim, slope.
585C*:				
Newhouse----------	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Valton----------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim, slope.
585D*:				
Newhouse----------	Fair: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Valton----------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
586C2*:				
Nodine	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim.
Rollingstone	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
586D2*:				
Nodine	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim, slope.
Rollingstone	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
592E*:				
Lamoille	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Elbaville	Poor: slope.	Improbable: large stones.	Improbable: large stones.	Poor: slope, small stones, area reclaim.
593F Elbaville	Poor: slope.	Improbable: large stones.	Improbable: large stones.	Poor: slope, small stones, area reclaim.
598B*:				
Beavercreek	Fair: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones.
Arenzville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
599E2 Norden	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
599F Norden	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
601D2 Council	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
601E Council	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
604*:				
Huntsville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Beavercreek	Fair: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
605D2---------- La Farge	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
606---------- Shiloh	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
608---------- Rawles	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
879B*:				
Newalbin----------	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Palms----------	Poor: wetness.	Improbable: excess humus, excess fines.	Improbable: excess humus, excess fines.	Poor: wetness, excess humus.
1010*. Riverwash				
1013*. Pits				
1016. Udorthents				
1812---------- Terril	Good----------	Probable----------	Improbable: too sandy.	Good.
1822B---------- Abscota Variant	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
1830---------- Eitzen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1838---------- Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1847---------- Kalmarville	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: wetness.
1856D---------- Plainfield	Fair: slope.	Improbable: thin layer.	Improbable: too sandy.	Poor: slope.
1856E---------- Plainfield	Poor: slope.	Improbable: thin layer.	Improbable: too sandy.	Poor: slope.
1857B---------- Eitzen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1858F*:				
Timula----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Lamont----------	Fair: slope.	Probable----------	Improbable: too sandy.	Poor: slope.
1860---------- Comfrey	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
1861B---------- Chaseburg	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1862---------- Zwingle Variant	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1885---------- Abscota	Fair: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy.
1886---------- Minneiska Variant	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
1888---------- Moundprairie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
1889---------- Moundprairie	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1890---------- Walford	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: wetness.
1893C---------- Beavercreek Variant	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
1898F*: Etter----------	Poor: slope.	Probable----------	Improbable: too sandy.	Poor: area reclaim, slope.
Brodale----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
1906D---------- Lindstrom	Fair: slope, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
8A---------- Sparta	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
11C---------- Sogn	Severe: depth to rock.	Slight---------	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
16---------- Arenzville	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily, too sandy.	Erodes easily.
18---------- Comfrey	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
25---------- Becker	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing---	Soil blowing, too sandy.	Favorable.
27B---------- Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing, slope.	Soil blowing, too sandy.	Favorable.
76A---------- Bertrand	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
76B---------- Bertrand	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
79B---------- Billett	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
79C---------- Billett	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, too sandy, soil blowing.	Slope.
81F---------- Boone	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
103A---------- Seaton	Moderate: seepage.	Moderate: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
103B---------- Seaton	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
103C2, 103D2------ Seaton	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
131B---------- Massbach	Moderate: seepage, depth to rock, slope.	Moderate: thin layer.	Deep to water	Percs slowly, rooting depth, slope.	Erodes easily	Erodes easily, rooting depth.
131C---------- Massbach	Severe: slope.	Moderate: thin layer.	Deep to water	Percs slowly, rooting depth, slope.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
136---------- Madelia	Moderate: seepage.	Severe: wetness, piping.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.
143E2---------- Eleva	Severe: slope, seepage.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
143F---------- Eleva	Severe: slope, seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
177B---------- Gotham	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
194---------- Huntsville	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Flooding-------	Favorable------	Favorable.
216B---------- Lamont	Severe: seepage.	Moderate: thin layer.	Deep to water	Slope, soil blowing.	Soil blowing---	Favorable.
244B---------- Lilah	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, rooting depth.	Too sandy, soil blowing.	Droughty, rooting depth.
250---------- Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Deep to water	Flooding-------	Favorable------	Favorable.
273---------- Muscatine	Moderate: seepage.	Moderate: wetness.	Frost action---	Wetness--------	Wetness, erodes easily.	Erodes easily.
283B---------- Plainfield	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
283C, 283D, 283F-- Plainfield	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Droughty, slope.
285A---------- Port Byron	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
285B---------- Port Byron	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
285C---------- Port Byron	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
298---------- Richwood	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
301B---------- Lindstrom	Moderate: slope, seepage.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
301C---------- Lindstrom	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
312B---------- Shullsburg	Moderate: depth to rock, slope.	Severe: hard to pack.	Percs slowly, depth to rock, frost action.	Wetness, percs slowly, depth to rock.	Depth to rock, wetness.	Wetness, depth to rock.
312C---------- Shullsburg	Severe: slope.	Severe: hard to pack.	Percs slowly, depth to rock, frost action.	Wetness, percs slowly, depth to rock.	Slope, depth to rock, wetness.	Wetness, slope, depth to rock.
322D2, 322E------- Timula	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
388C2, 388D2, 388E, 388F------- Seaton	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
401B---------- Mt. Carroll	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
401C, 401D-------- Mt. Carroll	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
455A---------- Festina	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
455B---------- Festina	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
455C2---------- Festina	Severe: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
457E, 457G-------- Lacrescent	Severe: seepage, slope.	Severe: seepage, piping, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
463---------- Minneiska	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing---	Favorable.
471---------- Root	Severe: seepage.	Severe: wetness, piping.	Flooding, frost action.	Flooding, wetness.	Wetness, large stones.	Large stones, wetness.
476B---------- Frankville	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, slope.	Erodes easily--	Erodes easily.
476C2, 476D------- Frankville	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, slope.	Slope, erodes easily.	Slope, erodes easily.
477---------- Littleton	Moderate: seepage.	Moderate: piping.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
484D---------- Eyota	Severe: slope, seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
488G---------- Brodale	Severe: slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
492B---------- Nasset	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, rooting depth.
492C---------- Nasset	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, slope.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
500C2, 500D2------ Edmund	Severe: slope.	Severe: thin layer.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
518---------- Kalmarville	Moderate: seepage.	Severe: piping, seepage.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
522---------- Boots	Severe: seepage.	Severe: excess humus, ponding.	Ponding, flooding, subsides.	Ponding, soil blowing, flooding.	Ponding, soil blowing.	Wetness.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
576, 577---------- Newalbin	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness---------	Wetness.
578---------- Newalbin	Moderate: seepage.	Severe: piping, ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding---------	Wetness.
580B*: Blackhammer------	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Southridge-------	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
580C2*, 580D2*: Blackhammer------	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Southridge-------	Severe: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
584F*: Lamoille---------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Large stones, percs slowly, slope.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
Dorerton---------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Large stones, slope.	Slope, large stones.	Large stones, slope.
585C*, 585D*: Newhouse---------	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Valton-----------	Severe: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
586C2*, 586D2*: Nodine-----------	Severe: slope.	Moderate: piping, large stones.	Deep to water	Slope, erodes easily.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
Rollingstone-----	Severe: slope.	Severe: hard to pack.	Deep to water	Large stones, percs slowly, slope.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
592E*: Lamoille---------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Large stones, percs slowly, slope.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
Elbaville--------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope----------	Slope, large stones, too sandy.	Slope, large stones.
593F---------- Elbaville	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope----------	Slope, large stones, too sandy.	Slope, large stones.
598B*: Beavercreek------	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, droughty.	Large stones, erodes easily.	Large stones, erodes easily.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
598B*: Arenzville	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily, too sandy.	Erodes easily.
599E2, 599F: Norden	Severe: slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
601D2, 601E: Council	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, soil blowing.	Slope.
604*: Huntsville	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Flooding	Favorable	Favorable.
Beavercreek	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, droughty.	Large stones	Large stones.
605D2: La Farge	Severe: slope.	Severe: thin layer.	Deep to water	Depth to rock, rooting depth, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
606: Shiloh	Slight	Severe: ponding.	Ponding, percs slowly, flooding.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
608: Rawles	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
879B*: Newalbin	Moderate: seepage, slope.	Severe: piping, wetness.	Flooding, frost action, slope.	Wetness, slope, flooding.	Wetness	Wetness.
Palms	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
1010*. Riverwash						
1013*. Pits						
1016. Udorthents						
1812: Terril	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable	Favorable	Favorable.
1822B: Abscota Variant	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
1830: Eitzen	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
1838: Colo	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Flooding, wetness.	Wetness	Wetness.
1847: Kalmarville	Moderate: seepage.	Severe: piping, seepage.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
1856D, 1856E: Plainfield	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1857B---------- Eitzen	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Favorable------	Favorable.
1858F*:						
Timula----------	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Lamont----------	Severe: slope, seepage.	Moderate: thin layer.	Deep to water	Slope, soil blowing.	Soil blowing, slope.	Slope.
1860---------- Comfrey	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
1861B---------- Chaseburg	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, flooding.	Erodes easily	Erodes easily.
1862---------- Zwingle Variant	Slight---------	Severe: hard to pack.	Percs slowly---	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Percs slowly.
1885---------- Abscota	Severe: seepage.	Severe: seepage, piping.	Flooding, cutbanks cave.	Fast intake, droughty, wetness.	Too sandy, soil blowing, wetness.	Droughty.
1886---------- Minneiska Variant	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Soil blowing---	Droughty.
1888---------- Moundprairie	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
1889---------- Moundprairie	Moderate: seepage.	Severe: piping, ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Ponding--------	Wetness.
1890---------- Walford	Slight---------	Severe: wetness.	Frost action---	Wetness--------	Wetness, erodes easily.	Wetness, erodes easily.
1893C---------- Beavercreek Variant	Severe: seepage.	Moderate: seepage, piping, large stones.	Deep to water	Slope, flooding.	Large stones---	Large stones.
1898F*:						
Etter----------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Soil blowing, slope.	Slope, too sandy, soil blowing.	Slope.
Brodale----------	Severe: slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
1906D---------- Lindstrom	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
8A---------- Sparta	0-20	Loamy sand-------	SM	A-2, A-4	0	85-100	85-100	50-95	15-50	---	NP
	20-38	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	85-100	85-100	50-95	5-50	---	NP
	38-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	85-100	85-100	50-95	2-30	---	NP
11C---------- Sogn	0-8	Silt loam--------	CL	A-6	0-10	85-100	85-100	85-100	70-95	25-40	11-23
	8-14	Very flaggy loam	CL	A-6	40-55	75-85	75-85	75-85	60-75	25-40	7-18
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
16---------- Arenzville	0-32	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	95-100	80-90	25-35	5-10
	32-46	Silt loam, loam	CL, CL-ML	A-4	0	100	100	90-100	85-95	<37	5-10
	46-60	Stratified silt loam to sand.	CL, CL-ML	A-4	0	75-100	70-95	65-95	50-85	20-30	5-10
18---------- Comfrey	0-8	Silt loam--------	ML, OL, CL	A-6, A-4	0	100	100	85-100	55-90	30-40	5-15
	8-29	Clay loam, loam	OL, OH, MH, ML	A-7	0	100	100	85-100	65-85	45-60	12-25
	29-60	Clay loam, loam, fine sandy loam.	CL, CL-ML, ML	A-7, A-6, A-4	0	100	100	80-100	60-85	35-50	12-25
25---------- Becker	0-22	Sandy loam-------	ML, CL-ML, CL	A-4	0	100	95-100	75-95	50-70	15-30	3-10
	22-28	Sandy loam, fine sandy loam, loam.	ML, SM	A-4	0	100	85-100	75-95	35-70	<25	NP-4
	28-34	Loamy coarse sand, loamy sand, gravelly loamy coarse sand.	SM	A-2, A-1	0	95-100	65-100	35-75	15-35	<20	NP
	34-60	Sand, loamy coarse sand, fine sand.	SM, SP-SM	A-1, A-2, A-3	0	95-100	65-100	35-70	5-15	<20	NP
27B---------- Dickinson	0-22	Sandy loam-------	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	22-34	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	34-37	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	37-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
76A, 76B---------- Bertrand	0-9	Silt loam--------	ML	A-4	0	100	100	90-100	85-90	25-35	3-10
	9-49	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	90-100	85-95	25-40	7-20
	49-60	Sand, fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	95-100	95-100	50-80	5-35	---	NP
79B, 79C---------- Billett	0-9	Sandy loam-------	SM, SM-SC	A-2, A-4	0	100	95-100	85-100	25-50	12-23	NP-5
	9-30	Sandy loam, loam	SM, SC, SM-SC	A-2, A-4, A-6	0	100	95-100	85-100	25-50	<25	NP-15
	30-60	Loamy sand, gravelly sand, sand.	GP-GM, GM, SM, SP-SM	A-1, A-2, A-3	0-5	25-100	20-100	20-75	5-30	<20	NP-5
81F---------- Boone	0-3	Sand-------------	SM, SP-SM	A-2, A-3, A-1	0	75-100	75-100	40-80	5-35	---	NP
	3-34	Fine sand, sand, loamy sand.	SM, SP-SM, SP	A-2, A-3, A-1	0	75-100	75-100	30-75	2-35	---	NP
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
103A, 103B, 103C2, 103D2---- Seaton	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	24-35	6-16
	9-60	Silt loam--------	CL	A-6, A-4	0	100	100	100	90-100	28-40	9-21
131B, 131C------- Massbach	0-29	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	30-40	10-20
	29-37	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	15-25
	37-45	Silty clay loam, silty clay, clay.	CL, CH	A-7, A-6	0-5	95-100	90-100	85-100	75-95	30-55	15-35
	45-60	Clay-------------	CH	A-7	20-25	100	100	95-100	90-100	50-80	25-50
136---------- Madelia	0-23	Silt loam--------	ML	A-7	0	100	100	100	90-100	40-50	10-20
	23-46	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	90-100	30-50	10-25
	46-60	Silt loam--------	ML, CL	A-6, A-4, A-7	0	100	100	100	90-100	30-50	5-25
143E2---------- Eleva	0-5	Loam-------------	ML, CL-ML	A-4	0	95-100	80-100	70-95	50-75	<25	3-7
	5-28	Loam, sandy loam, fine sandy loam.	ML, CL, SM, SC	A-2, A-4	0	95-100	80-100	50-95	25-75	20-28	4-9
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
143F---------- Eleva	0-12	Sandy loam-------	SM, SM-SC, ML, CL-ML	A-2, A-4	0	95-100	80-100	50-90	25-55	<25	2-7
	12-31	Loam, sandy loam, fine sandy loam.	ML, CL, SM, SC	A-2, A-4	0	95-100	80-100	50-95	25-75	20-28	4-9
	31-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
177B---------- Gotham	0-9	Loamy sand-------	SM, SP-SM	A-2, A-3, A-1	0	100	95-100	35-75	5-25	---	NP
	9-32	Loamy fine sand, loamy sand, fine sand.	SM, SP-SM, SP	A-2, A-3, A-1	0	95-100	75-100	35-75	3-25	---	NP
	32-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3, A-1	0	95-100	75-100	35-75	1-20	---	NP
194---------- Huntsville	0-33	Silt loam--------	CL	A-6	0	100	95-100	90-100	85-100	25-40	10-20
	33-60	Silt loam--------	CL	A-6	0	100	95-100	90-100	85-100	20-35	10-20
216B---------- Lamont	0-9	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	80-95	25-50	15-25	5-10
	9-60	Fine sandy loam, loam, sandy clay loam, sandy loam.	SM-SC, SC	A-2, A-4	0	100	100	85-95	30-50	20-30	5-10
244B---------- Lilah	0-9	Sandy loam-------	SM-SC, SC	A-2, A-4	0-5	90-95	80-90	60-70	25-40	<25	5-10
	9-19	Sandy loam, gravelly loamy sand, sand.	SW, SW-SM, SP, SP-SM	A-1-b	0-10	70-80	50-70	30-50	3-12	---	NP
	19-60	Gravelly loamy sand, sand, gravelly sand.	GP, SP, GP-GM, SP-SM	A-1-b	0-10	50-60	40-50	30-50	3-12	---	NP
250---------- Kennebec	0-48	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	48-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
273---------- Muscatine	0-15	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	15-42	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	42-60	Silt loam--------	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
283B, 283C, 283D, 283F---------- Plainfield	0-4	Sand-------------	SP-SM, SM, SP	A-3, A-2, A-1	0	75-100	75-100	40-80	3-35	---	NP
	4-28	Sand-------------	SP	A-3, A-1, A-2	0	75-100	75-100	40-70	1-4	---	NP
	28-60	Sand, fine sand	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP
285A, 285B, 285C- Port Byron	0-13	Silt loam--------	CL	A-4, A-6	0	100	100	100	95-100	25-40	7-18
	13-60	Silt loam--------	CL	A-4, A-6	0	100	100	100	95-100	25-40	7-18

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
298---------- Richwood	0-14	Silt loam--------	ML	A-4	0	100	100	90-100	85-95	25-35	3-10
	14-42	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-95	20-35	5-15
	42-45	Sandy loam-------	CL, ML, SC, SM	A-4	0	100	100	85-95	35-75	<25	2-10
	45-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-35	---	NP
301B, 301C------- Lindstrom	0-27	Silt loam--------	ML	A-4	0	100	100	95-100	85-95	30-40	5-10
	27-60	Silt loam--------	ML, CL	A-4, A-6	0	100	100	95-100	85-95	30-40	9-14
312B, 312C------- Shullsburg	0-9	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	85-90	20-40	1-15
	9-16	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	85-90	30-45	11-25
	16-22	Silty clay, clay	CL, CH	A-7	0	100	85-100	80-100	80-95	40-70	20-45
	22-60	Clay-------------	CH	A-7	20-25	100	100	95-100	90-100	50-80	25-50
322D2, 322E------ Timula	0-60	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	85-100	26-35	5-10
388C2, 388D2----- Seaton	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	24-35	6-16
	9-60	Silt loam--------	CL	A-6, A-4	0	100	100	100	90-100	28-40	9-21
388E, 388F------- Seaton	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	24-35	6-16
	8-42	Silt loam--------	CL	A-6, A-4	0	100	100	100	90-100	28-40	9-21
	42-60	Silt loam, silt	CL, CL-ML	A-4, A-6	0	100	100	100	90-100	26-40	5-17
401B, 401C, 401D- Mt. Carroll	0-8	Silt loam--------	CL	A-4, A-6	0	100	100	100	95-100	25-36	7-18
	8-60	Silt loam--------	CL	A-6, A-4	0	100	100	100	95-100	27-40	8-20
455A, 455B, 455C2---------- Festina	0-8	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	8-36	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	95-100	30-40	10-20
	36-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
457E------------ Lacrescent	0-17	Cobbly silt loam	CL	A-6, A-7	15-30	80-100	70-100	60-95	50-90	30-45	10-20
	17-28	Very cobbly silt loam, cobbly fine sandy loam, very cobbly loam.	SM, SC, ML, CL	A-4, A-6, A-2, A-1	30-55	55-80	45-70	40-65	20-60	20-35	3-12
	28-60	Cobbly loam, very cobbly silt loam, very cobbly fine sandy loam.	SM, SC, ML, CL	A-4, A-6, A-2, A-1	50-65	50-75	40-65	35-60	15-55	10-35	NP-12
457G------------ Lacrescent	0-17	Cobbly silty clay loam, cobbly silt loam.	CL	A-6, A-7	15-30	80-100	70-100	60-95	50-90	30-45	10-20
	17-28	Very cobbly silt loam, cobbly fine sandy loam, very cobbly loam.	SM, SC, ML, CL	A-4, A-6, A-2, A-1	30-55	55-80	45-70	40-65	20-60	20-35	3-12
	28-60	Cobbly loam, very cobbly silt loam, very cobbly fine sandy loam.	SM, SC, ML, CL	A-4, A-6, A-2, A-1	50-65	50-75	40-65	35-60	15-55	10-35	NP-12
463---------- Minneiska	0-11	Fine sandy loam	SM	A-4	0	100	95-100	50-70	35-50	<20	NP-4
	11-60	Stratified silt loam to sand.	SM, ML	A-4	0	100	85-100	50-90	35-60	20-30	NP-5
471---------- Root	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0-10	70-95	70-95	70-95	60-75	25-35	5-15
	12-60	Very cobbly sandy loam, gravelly loamy sand, cobbly sandy loam.	GP, GM, SM, SP	A-1, A-2, A-3	25-60	20-80	15-75	10-60	3-35	<20	NP

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
476B, 476C2, 476D---------- Frankville	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	12-28	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	28-35	Clay, silty clay	CH	A-7	2-10	85-95	80-90	70-85	65-80	50-70	30-45
	35-48	Very flaggy silty clay.	GC	A-2-7	70-90	25-65	20-50	15-45	15-40	45-70	20-45
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
477---------- Littleton	0-39	Silt loam--------	CL	A-4, A-6	0	100	100	98-100	90-100	29-40	8-19
	39-60	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	98-100	80-100	23-45	7-25
484D---------- Eyota	0-38	Sandy loam--------	SM, SM-SC	A-4	0	90-100	85-100	60-90	35-50	<20	NP-5
	38-60	Loam, sandy loam, silt loam.	SM, ML, CL-ML, SM-SC	A-4	0	90-100	85-100	60-90	35-70	<20	NP-5
488G---------- Brodale	0-12	Cobbly fine sandy loam, very cobbly loam.	SM, SP-SM, SC, GM	A-2, A-1	7-30	30-65	20-55	15-45	8-35	12-30	NP-8
	12-20	Cobbly very fine sandy loam, very cobbly loam, cobbly sandy loam.	SM, SC, GM, GC	A-2, A-4, A-1, A-6	20-50	30-65	20-55	15-45	12-45	10-35	NP-12
	20-60	Cobbly very fine sandy loam, very cobbly loam, cobbly sandy loam.	SM, SC, SM-SC, GM	A-2, A-1	20-50	45-80	40-75	25-50	10-35	12-30	NP-8
492B, 492C------- Nasset	0-8	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	8-45	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	45-54	Clay, silty clay	CH	A-7	2-10	85-95	80-90	70-85	65-85	50-70	30-45
	54-60	Very flaggy silty clay.	GC	A-2-7	70-90	25-65	20-50	15-45	15-40	45-70	20-45
500C2, 500D2----- Edmund	0-14	Silt loam--------	CL	A-6, A-7	0-10	85-100	80-100	80-100	60-90	30-45	10-25
	14-20	Silty clay, clay	CH	A-7	0-10	70-100	70-100	70-100	70-95	55-80	30-50
	20-36	Very flaggy silty clay.	GC	A-2-7	70-90	25-65	20-50	15-45	15-40	45-70	20-45
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
518---------- Kalmarville	0-10	Silty clay loam	ML, CL	A-6, A-7	0	95-100	95-100	85-100	70-90	30-50	10-20
	10-27	Fine sandy loam, loam, silt loam.	ML, SM, SM-SC, CL-ML	A-4, A-2	0	95-100	90-100	60-85	30-60	15-25	NP-5
	27-60	Coarse sand, sand, loamy fine sand.	SP, SM, SW, SP-SM	A-3, A-2, A-1	0-2	90-100	85-100	40-80	2-30	<25	NP
522---------- Boots	0-60	Hermic material--	Pt	A-8	0	---	---	---	---	---	---
576, 577, 578---- Newalbin	0-3	Silt loam--------	CL, CL-ML	A-4	0	100	100	90-100	85-98	20-30	4-10
	3-57	Silt loam, loam, very fine sand.	CL, CL-ML	A-4	0	100	100	90-100	85-98	20-30	4-10
	57-60	Silt loam, loam, fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	80-98	25-45	4-20

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
580B*, 580C2*, 580D2*:											
Blackhammer----	0-10	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	95-100	90-100	85-100	70-95	18-40	3-15
	10-27	Silt loam--------	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-100	70-90	20-40	5-15
	27-60	Stratified sand to clay loam.	CL, SC, SM-SC	A-4, A-2, A-7, A-6	5-20	75-95	65-92	60-90	30-70	25-50	7-25
Southridge-----	0-8	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	98-100	98-100	15-25	3-10
	8-33	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	15-35	4-15
	33-60	Clay-------------	CH	A-7	2-10	75-100	65-90	65-90	60-90	50-70	20-40
584F*:											
Lamoille--------	0-13	Silt loam--------	CL, CL-ML	A-6, A-4	0-2	95-100	90-100	90-100	80-100	18-35	4-15
	13-27	Clay, clay loam, gravelly clay.	GC, SC, CL, CH	A-7	5-25	65-95	55-85	50-80	40-70	40-65	15-40
	27-37	Cobbly loam, cobbly clay loam, very cobbly clay loam.	GC, SC	A-6, A-7, A-2	10-50	30-75	25-65	15-55	12-45	35-60	15-35
	37-60	Cobbly loam, cobbly sandy loam, very cobbly loam.	GC, GM	A-2, A-1, A-4	45-60	25-60	20-55	15-50	12-40	18-30	4-10
Dorerton--------	0-6	Silt loam--------	ML	A-4	0	100	100	70-95	55-90	20-30	NP-5
	6-11	Loam, clay loam, silt loam.	CL, ML	A-4, A-6	0-5	95-100	85-100	70-95	50-85	30-40	5-15
	11-25	Cobbly loam, very cobbly clay loam, very cobbly loam.	GM, GC, SM, SC	A-2, A-1	20-55	40-75	30-65	20-45	12-35	30-45	5-20
	25-60	Very cobbly loam, cobbly loam.	GW-GM, SP-SM, SM	A-1, A-2	20-55	40-75	30-65	15-40	5-30	<20	NP
585C*, 585D*:											
Newhouse--------	0-9	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	90-100	80-100	70-95	20-40	4-16
	9-25	Silt loam, silty clay loam.	CL	A-4, A-6	0	95-100	90-100	85-100	70-90	25-40	7-20
	25-60	Stratified fine sandy loam to clay loam.	SC, CL, GC	A-2, A-4, A-6, A-7	2-25	70-95	65-92	50-85	30-75	25-50	7-25
Valton----------	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0-25	75-100	75-100	70-100	55-100	20-40	4-17
	9-33	Silt loam, silty clay loam.	CL	A-6, A-7, A-4	0-25	75-100	75-100	70-100	55-100	25-45	9-22
	33-60	Clay, cherty clay, silty clay.	CH, CL, SC	A-7	0-25	50-95	50-95	45-95	40-90	45-85	25-55
586C2*, 586D2*:											
Nodine----------	0-7	Silt loam--------	CL, ML	A-4, A-6	0-5	95-100	92-100	90-100	90-100	20-35	3-15
	7-10	Silt loam--------	CL, CL-ML	A-4, A-6	0-10	95-100	92-100	90-100	90-100	25-40	5-15
	10-60	Stratified clay to loamy sand.	CL, SC	A-7, A-6, A-4, A-2	5-30	85-95	75-95	60-85	30-65	25-50	8-25
Rollingstone----	0-6	Silt loam--------	CL, ML, CL-ML	A-4	0-5	95-100	92-100	90-100	90-100	15-25	3-10
	6-13	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0-5	95-100	92-100	90-100	90-100	15-30	3-15
	13-60	Clay, cherty clay	CH, SC, GC	A-7	10-35	60-90	55-85	50-80	40-70	50-70	20-40

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
592E*:											
Lamoille	0-13	Silt loam	CL, CL-ML	A-6, A-4	0-2	95-100	90-100	90-100	80-100	18-35	4-15
	13-27	Clay, clay loam, gravelly clay.	GC, SC, CL, CH	A-7	5-25	65-95	55-85	50-80	40-70	40-65	15-40
	27-37	Cobbly loam, cobbly clay loam, very cobbly clay loam.	GC, SC	A-6, A-7, A-2	10-50	30-75	25-65	15-55	12-45	35-60	15-35
	37-60	Cobbly loam, cobbly sandy loam, very cobbly loam.	GC, GM	A-2, A-1, A-4	45-60	25-60	20-55	15-50	12-40	18-30	4-10
Elbaville	0-12	Silt loam	ML, CL-ML, CL	A-4	0	100	100	90-100	50-90	20-30	3-8
	12-22	Silty clay loam, silt loam.	CL	A-4, A-6, A-7	0	100	100	95-100	80-95	30-45	8-20
	22-31	Silty clay, silty clay loam, gravelly clay loam.	CL, CH, MH, ML	A-7	0-20	90-100	80-100	75-100	70-95	40-65	20-32
	31-60	Very cobbly loam, very cobbly sandy loam.	GC, GM	A-2, A-4	20-70	35-75	30-70	25-65	20-50	18-30	4-10
593F---------- Elbaville	0-12	Silt loam	ML, CL-ML, CL	A-4	0	100	100	90-100	50-90	20-30	3-8
	12-22	Silty clay loam, silt loam.	CL	A-4, A-6, A-7	0	100	100	95-100	80-95	30-45	8-20
	22-31	Silty clay, silty clay loam, gravelly clay loam.	CL, CH, MH, ML	A-7	0-20	90-100	80-100	75-100	70-95	40-65	20-32
	31-60	Very cobbly loam, very cobbly sandy loam, cobbly fine sandy loam.	GC, GM	A-2, A-4	20-70	35-75	30-70	25-65	20-50	18-30	4-10
598B*:											
Beavercreek	0-5	Cobbly fine sandy loam, fine sandy loam.	SM	A-2, A-4	1-25	70-100	50-75	35-70	25-50	20-35	NP-10
	5-12	Stratified cobbly fine sand, silt loam, fine sand.	SM	A-2, A-4	1-25	70-100	65-92	35-70	15-45	20-35	NP-10
	12-60	Stratified very cobbly sand, cobbly silt loam, cobbly sand.	GM, SM	A-1, A-2	30-60	45-80	40-70	25-50	10-30	20-35	NP-10
Arenzville	0-32	Silt loam	ML, CL-ML, CL	A-4	0	100	100	95-100	80-90	25-35	5-10
	32-46	Silt loam, silty clay loam, loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	85-95	20-45	5-20
	46-60	Stratified silt loam to sand.	CL, CL-ML	A-4	0	75-100	70-95	65-95	50-85	20-30	5-10
599E2, 599F------ Norden	0-5	Silt loam	ML, CL, SM, SC	A-4, A-6	0	75-100	70-100	60-100	40-90	20-30	3-12
	5-23	Loam, clay loam, sandy clay loam.	CL, SC	A-6, A-2	0	75-100	70-100	55-100	25-85	25-40	10-25
	23-30	Sandy loam, sandy clay loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4, A-1	0-5	75-100	70-100	35-95	15-55	<30	NP-7
	30-47	Weathered bedrock,	---	---	---	---	---	---	---	---	---
	47	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
601D2, 601E----- Council	0-7	Sandy loam-------	ML, SM	A-4, A-2	0	75-100	75-100	45-95	25-65	<20	NP-4
	7-23	Loam, silt loam, sandy loam.	CL, CL-ML, SC, SM-SC	A-4	0	75-100	75-100	65-100	45-90	12-28	4-9
	23-54	Loam, silt loam	ML, CL, SM, SC	A-4	0	75-100	75-100	65-100	45-90	16-31	3-10
	54-60	Loam-------------	ML, CL-ML	A-4	0	95-100	80-100	70-95	50-75	<25	3-10
604*:											
Huntsville------	0-33	Silt loam--------	CL	A-6	0	100	95-100	90-100	85-100	25-40	10-20
	33-60	Silt loam--------	CL	A-6	0	100	95-100	90-100	85-100	20-35	10-20
Beavercreek-----	0-5	Silt loam--------	ML, CL-ML	A-4	0-5	90-100	75-95	65-90	50-85	25-40	4-10
	5-12	Stratified cobbly silt loam to cobbly fine sand.	SM	A-2, A-4	1-25	70-100	65-92	35-70	15-45	20-35	NP-10
	12-60	Stratified very cobbly silt loam to very cobbly sand.	GM, SM	A-1, A-2	30-60	45-80	40-70	25-50	10-30	20-35	NP-10
605D2-----------	0-7	Silt loam--------	CL, CL-ML	A-4	0	100	100	90-100	85-95	20-30	5-10
La Farge	7-33	Silt loam, silty clay loam.	CL	A-6	0	100	100	90-100	85-95	25-40	10-25
	33-43	Fine sandy loam, loam, clay loam.	CL, SC	A-6	0	95-100	95-100	85-100	45-65	20-35	10-20
	43	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
606-----------	0-16	Silty clay-------	CL, CH	A-7	0	100	100	98-100	90-100	43-55	20-32
Shiloh	16-60	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	100	100	98-100	90-100	41-56	19-34
608-----------	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	90-100	25-40	5-15
Rawles	9-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	90-100	30-45	10-20
879B*:											
Newalbin--------	0-3	Silt loam--------	CL, CL-ML	A-4	0	100	100	90-100	85-98	20-30	4-10
	3-43	Silt loam, loam, very fine sandy loam.	CL, CL-ML	A-4	0	100	100	90-100	85-98	20-30	4-10
	43-60	Muck, sapric material.	Pt	---	0	---	---	---	---	---	---
Palms-----------	0-35	Sapric material	Pt	---	---	---	---	---	---	---	---
	35-60	Clay loam, silt loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
1010*. Riverwash											
1013*. Pits											
1016. Udorthents											
1812-----------	0-8	Loam-------------	CL	A-4, A-6	0-5	100	95-100	70-90	60-80	25-40	8-15
Terril	8-46	Loam, clay loam	CL	A-4, A-6	0-5	100	90-100	70-90	60-80	25-40	8-15
	46-60	Sand, gravelly sand, loamy sand.	SP-SM, SM	A-2-4	0-25	90-100	75-90	60-80	10-35	---	NP
1822B-----------	0-3	Sand-------------	SM, SP-SM	A-3, A-2-4	0	95-100	90-100	50-70	5-20	<20	NP-4
Abscota Variant	3-60	Stratified sand to silt loam.	SM, SP-SM	A-2-4	0	95-100	90-100	50-75	10-30	<20	NP-4

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1830---------- Eitzen	0-25	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	98-100	92-100	75-100	25-40	5-18
	25-48	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	98-100	92-100	85-95	25-40	5-20
	48-60	Silt loam, loam	CL, CL-ML	A-6, A-4	0	100	90-100	85-100	80-95	25-40	5-20
1838---------- Colo	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	8-40	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	40-60	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
1847---------- Kalmarville	0-10	Fine sandy loam	SM	A-4	0	95-100	90-100	60-85	35-50	<25	NP-4
	10-27	Fine sandy loam, sandy loam, silt loam.	ML, SM, SM-SC, CL-ML	A-4, A-2	0	95-100	90-100	60-85	30-60	15-25	NP-5
	27-60	Coarse sand, sand, loamy fine sand.	SP, SM, SW, SP-SM	A-3, A-2, A-1	0-2	90-100	85-100	40-80	2-30	<25	NP
1856D, 1856E----- Plainfield	0-8	Loamy fine sand	SM	A-2	0	95-100	75-95	50-85	15-35	---	NP
	8-50	Sand----------	SP, SP-SM, SM	A-2, A-3	0	95-100	75-85	50-70	3-15	---	NP
	50-60	Loam, sandy loam, silt loam.	CL, SC	A-4, A-6	0-5	85-100	80-95	60-90	35-80	25-40	7-16
1857B---------- Eitzen	0-25	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	98-100	92-100	75-100	25-40	5-18
	25-48	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	98-100	92-100	85-95	25-40	5-20
	48-60	Silt loam, loam	CL, CL-ML	A-6, A-4	0	100	90-100	85-100	80-95	25-40	5-20
1858F*:											
Timula----------	0-60	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	85-100	26-35	5-10
Lamont----------	0-9	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	80-95	25-50	15-25	5-10
	9-60	Fine sandy loam, loam, sandy clay loam.	SM-SC, SC	A-2, A-4	0	100	100	85-95	30-50	20-30	5-10
1860---------- Comfrey	0-8	Silty clay loam	OH, ML, CL, CH	A-7	0	100	100	90-100	65-95	40-55	15-25
	8-29	Clay loam, loam	OL, OH, MH, ML	A-7	0	100	100	85-100	65-85	45-60	12-25
	29-60	Clay loam, fine sandy loam, loam.	CL, ML, CL-ML	A-7, A-6, A-4	0	100	100	80-100	60-85	20-50	5-25
1861B---------- Chaseburg	0-7	Silt loam--------	ML, CL-ML	A-4	0	100	100	90-100	85-100	<25	NP-5
	7-60	Silt loam--------	ML, CL-ML	A-4	0	100	100	90-100	85-100	<25	NP-5
1862---------- Zwingle Variant	0-6	Silty clay-------	CL, CH, MH	A-7	0	100	100	95-100	85-100	40-60	20-30
	6-47	Clay----------	CH	A-7	0	100	100	95-100	90-100	55-70	35-45
	47-60	Stratified silty clay to silt loam.	CL, CH	A-7, A-6	0	100	95-100	90-100	75-95	35-60	15-35
1885---------- Abscota	0-8	Loamy sand-------	SM	A-2-4	0	95-100	95-100	50-75	15-30	---	NP
	8-60	Sand, loamy fine sand, loamy sand.	SP, SM, SP-SM	A-2-4, A-1, A-3	0	95-100	95-100	45-65	0-15	---	NP
1886---------- Minneiska Variant	0-9	Loamy fine sand	SM	A-2-4	0	100	100	50-80	10-30	<20	NP
	9-29	Stratified fine sand to silt loam.	SM	A-2-4	0	100	100	65-85	10-30	<20	NP-4
	29-60	Silt loam, loam, fine sandy loam.	CL, SM, CL-ML	A-4, A-6	0	100	100	65-95	35-75	15-40	4-15
1888, 1889------- Moundprairie	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-100	35-50	12-25
	10-40	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	90-100	85-95	22-50	7-25
	40-60	Silt loam, silty clay loam, loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	85-95	65-85	22-50	5-25

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1890---------- Walford	0-9	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-35	10-15
	9-18	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	18-34	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	34-60	Silt loam--------	CL	A-6	0	100	100	100	95-100	35-40	15-20
1893C---------- Beavercreek Variant	0-15	Silt loam--------	SM, ML, CL-ML, SM-SC	A-4	0-8	60-80	55-75	45-70	35-60	20-35	2-10
	15-23	Loam, fine sandy loam.	SM, ML, CL-ML, SM-SC	A-4, A-2-4	0-15	60-80	55-75	45-70	30-60	20-35	2-10
	23-60	Cobbly fine sandy loam, cobbly loam, cobbly sandy loam.	SM, SC, GM, GC	A-2-4, A-4, A-1-b	25-40	60-75	55-70	35-65	20-45	15-30	2-8
1898F*:											
Etter----------	0-8	Sandy loam--------	ML, SM	A-4	0-1	95-100	95-100	70-95	40-55	17-35	NP-10
	8-17	Loam, sandy loam, fine sandy loam.	ML, SM	A-4	0-2	95-100	95-100	80-90	45-75	20-35	3-10
	17-22	Loamy fine sand, loamy sand, fine sand.	SM, SP-SM	A-2	2-10	90-100	50-100	40-90	10-35	<20	NP
	22-60	Sand, fine sand	SP-SM, SM	A-3, A-2, A-1	2-15	85-100	50-100	30-85	5-15	<20	NP
Brogale----------	0-12	Loam--------------	SM, SP-SM, SC, GM	A-2, A-1	7-15	30-65	20-55	15-45	8-35	12-30	NP-8
	12-40	Flaggy loam, flaggy silt loam, cobbly sandy loam.	SM, SC, SM-SC, GM	A-2, A-1	20-50	45-80	40-75	25-50	10-35	12-30	NP-8
	40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
1906D---------- Lindstrom	0-25	Loam--------------	ML	A-4	0	100	100	95-100	85-95	30-40	5-10
	25-60	Silt loam--------	ML, CL	A-4, A-6	0	100	100	95-100	85-95	30-40	9-14

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
8A	0-20	3-10	1.20-1.40	2.0-6.0	0.09-0.12	5.1-7.3	Low	0.17	5	2	1-2
Sparta	20-38	1-8	1.40-1.60	6.0-20	0.05-0.11	5.1-6.0	Low	0.17			
	38-60	0-5	1.50-1.70	6.0-20	0.04-0.07	5.1-6.0	Low	0.17			
11C	0-8	18-25	1.15-1.20	0.6-2.0	0.17-0.22	6.1-7.3	Moderate	0.32	1	4L	2-4
Sogn	8-14	10-25	1.20-1.45	0.6-2.0	0.08-0.14	6.1-7.3	Low	0.32			
	14	---	---	---	---	---	---	---			
16	0-32	10-18	1.20-1.55	0.6-2.0	0.20-0.24	6.6-7.8	Low	0.37	5	5	1-3
Arenzville	32-46	10-30	1.25-1.45	0.6-2.0	0.18-0.22	6.6-7.8	Moderate	0.37			
	46-60	5-20	1.20-1.40	0.6-2.0	0.12-0.16	5.6-7.8	Low	0.37			
18	0-8	18-27	1.20-1.40	0.6-2.0	0.20-0.24	5.1-6.6	Low	0.28	5	6	6-10
Comfrey	8-29	18-35	1.20-1.40	0.6-2.0	0.16-0.20	5.1-6.6	Moderate	0.28			
	29-60	18-35	1.30-1.50	0.6-2.0	0.15-0.19	6.6-8.4	Moderate	0.28			
25	0-22	5-18	1.45-1.55	2.0-6.0	0.16-0.20	5.6-7.3	Low	0.20	4	3	2-5
Becker	22-28	5-18	1.45-1.55	2.0-6.0	0.15-0.20	5.6-7.3	Low	0.20			
	28-34	2-10	1.55-1.65	6.0-20	0.05-0.10	6.1-7.3	Low	0.15			
	34-60	1-10	1.60-1.70	6.0-20	0.02-0.07	6.1-7.8	Low	0.15			
27B	0-22	12-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.20	4	3	1-2
Dickinson	22-34	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.0	Low	0.20			
	34-37	5-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.0	Low	0.20			
	37-60	5-10	1.60-1.70	6.0-20	0.02-0.04	5.6-6.5	Low	0.15			
76A, 76B	0-9	15-22	1.35-1.60	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.37	5	5	1-3
Bertrand	9-49	18-30	1.55-1.65	0.6-2.0	0.18-0.22	5.1-6.0	Moderate	0.37			
	49-60	1-4	1.55-1.65	6.0-20	0.05-0.07	5.1-6.0	Low	0.15			
79B, 79C	0-9	8-12	1.40-1.70	2.0-6.0	0.13-0.17	5.1-6.0	Low	0.20	5	3	1-2
Billett	9-30	10-18	1.40-1.70	2.0-6.0	0.12-0.14	5.6-7.3	Low	0.20			
	30-60	2-7	1.60-1.90	6.0-20	0.02-0.08	5.1-7.8	Low	0.10			
81F	0-3	2-3	1.55-1.65	6.0-20	0.07-0.10	6.1-6.5	Low	0.15	4	1	<1
Boone	3-34	0-3	1.55-1.70	6.0-20	0.04-0.11	6.1-6.5	Low	0.15			
	34-60	---	---	---	---	---	---	---			
103A, 103B, 103C2, 103D2	0-9	15-22	1.10-1.20	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.37	5-4	6	1-3
Seaton	9-60	18-27	1.15-1.30	0.6-2.0	0.20-0.22	5.1-6.5	Low	0.37			
131B, 131C	0-29	22-27	1.15-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.32	4	6	2-4
Massbach	29-37	25-35	1.30-1.60	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.43			
	37-45	35-50	1.60-1.80	0.06-0.2	0.11-0.18	6.1-7.3	Moderate	0.32			
	45-60	35-50	1.60-1.80	0.06-0.2	0.11-0.18	6.1-7.8	Moderate	0.32			
136	0-23	18-35	1.20-1.30	0.6-2.0	0.18-0.24	6.1-7.3	Moderate	0.28	5	6	4-8
Madelia	23-46	18-35	1.25-1.35	0.6-2.0	0.16-0.22	5.6-6.5	Moderate	0.28			
	46-60	18-27	1.30-1.40	0.6-2.0	0.16-0.22	7.4-8.4	Low	0.37			
143E2	0-5	5-15	1.40-1.70	0.6-2.0	0.17-0.22	5.1-7.3	Low	0.24	4	5	1-3
Eleva	5-28	10-18	1.50-1.70	0.6-6.0	0.10-0.19	5.1-6.5	Low	0.24			
	28-60	---	---	---	---	---	---	---			
143F	0-12	5-15	1.40-1.70	2.0-6.0	0.12-0.18	5.1-7.3	Low	0.24	4	3	1-3
Eleva	12-31	10-18	1.50-1.70	0.6-6.0	0.10-0.19	5.1-6.5	Low	0.24			
	31-60	---	---	---	---	---	---	---			
177B	0-9	2-4	1.35-1.55	2.0-6.0	0.10-0.12	5.6-7.3	Low	0.17	5	2	.5-2
Gotham	9-32	2-4	1.40-1.60	6.0-20	0.06-0.11	5.1-7.3	Low	0.17			
	32-60	1-3	1.50-1.70	6.0-20	0.05-0.10	5.1-7.3	Low	0.17			
194	0-33	18-27	1.15-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Moderate	0.28	5	6	3-4
Huntsville	33-60	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate	0.28			

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
216B----------	0-9	10-15	1.50-1.55	2.0-6.0	0.16-0.18	5.1-7.3	Low----------	0.24	5	3	.5-1
Lamont	9-60	10-22	1.45-1.65	2.0-6.0	0.14-0.16	5.1-6.0	Low----------	0.24			
244B----------	0-9	5-13	1.50-1.55	2.0-6.0	0.11-0.13	5.1-6.0	Low----------	0.20	2	3	<1
Lilah	9-19	2-10	1.55-1.80	>20	0.02-0.04	5.1-6.0	Low----------	0.20			
	19-60	2-6	1.55-1.85	>20	0.02-0.04	5.1-6.0	Low----------	0.20			
250----------	0-48	22-30	1.25-1.35	0.6-2.0	0.22-0.24	6.6-7.8	Moderate-----	0.32	5	6	5-6
Kennebec	48-60	24-28	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43			
273----------	0-15	24-27	1.28-1.32	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.28	5	6	5-6
Muscatine	15-42	30-34	1.28-1.35	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.43			
	42-60	22-26	1.35-1.40	0.6-2.0	0.18-0.20	6.6-7.8	Moderate-----	0.43			
283B, 283C, 283D, 283F----------	0-4	2-9	1.35-1.65	6.0-20	0.04-0.09	4.5-7.3	Low----------	0.15	5	1	<1
Plainfield	4-28	1-4	1.50-1.65	6.0-20	0.04-0.07	4.5-6.5	Low----------	0.17			
	28-60	1-4	1.50-1.75	6.0-20	0.04-0.07	4.5-6.5	Low----------	0.17			
285A, 285B, 285C-	0-13	18-27	1.10-1.20	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	5-4	6	2-4
Port Byron	13-60	15-27	1.15-1.30	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.43			
298----------	0-14	15-22	1.35-1.60	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.28	5	5	2-5
Richwood	14-42	18-34	1.55-1.65	0.6-2.0	0.18-0.22	5.6-7.3	Moderate-----	0.43			
	42-45	10-20	1.55-1.65	0.6-6.0	0.10-0.22	5.6-7.3	Low----------	0.43			
	45-60	1-4	1.55-1.65	6.0-20	0.05-0.07	6.1-7.3	Low----------	0.15			
301B, 301C-------	0-27	18-24	1.20-1.30	0.6-2.0	0.22-0.26	5.6-7.3	Low----------	0.32	5	5	3-5
Lindstrom	27-60	18-24	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.43			
312B, 312C-------	0-9	22-35	1.40-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.32	4	6	4-7
Shullsburg	9-16	24-35	1.40-1.50	0.2-0.6	0.18-0.22	5.6-7.3	Moderate-----	0.32			
	16-22	40-70	1.50-1.60	0.06-0.2	0.12-0.16	6.1-7.8	High---------	0.32			
	22-60	40-70	1.50-1.60	0.06-0.2	0.12-0.16	6.1-7.8	High---------	0.32			
322D2, 322E------	0-60	10-18	1.30-1.60	0.6-2.0	0.20-0.24	6.1-8.4	Low----------	0.37	5-4	5	1-2
Timula											
388C2, 388D2-----	0-9	15-22	1.10-1.20	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5-4	6	1-3
Seaton	9-60	18-27	1.15-1.30	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.37			
388E, 388F-------	0-8	15-22	1.10-1.20	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5-4	6	1-3
Seaton	8-42	18-27	1.15-1.30	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.37			
	42-60	15-25	1.20-1.40	0.6-2.0	0.20-0.22	5.6-8.4	Low----------	0.37			
401B, 401C, 401D-	0-8	15-22	1.10-1.20	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	5-4	6	2-3
Mt. Carroll	8-60	18-27	1.15-1.30	0.6-2.0	0.20-0.22	5.1-6.0	Low----------	0.43			
455A, 455B, 455C2----------	0-8	18-24	1.30-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	5	6	2-3
Festina	8-36	24-29	1.35-1.40	0.6-2.0	0.20-0.22	5.6-6.0	Moderate-----	0.43			
	36-60	22-26	1.40-1.45	0.6-2.0	0.20-0.22	6.1-6.5	Moderate-----	0.43			
457E----------	0-17	18-33	1.25-1.40	0.6-2.0	0.15-0.22	6.6-7.3	Low----------	0.24	2	8	3-5
Lacrescent	17-28	8-23	1.30-1.50	0.6-6.0	0.06-0.09	6.6-7.3	Low----------	0.24			
	28-60	8-20	1.30-1.50	2.0-6.0	0.05-0.08	7.4-7.8	Low----------	0.24			
457G----------	0-17	18-33	1.25-1.40	0.6-2.0	0.15-0.22	6.6-7.3	Low----------	0.24	2	8	3-5
Lacrescent	17-28	8-23	1.30-1.50	0.6-6.0	0.06-0.09	6.6-7.3	Low----------	0.24			
	28-60	8-20	1.30-1.50	2.0-6.0	0.05-0.08	7.4-7.8	Low----------	0.24			
463----------	0-11	5-18	1.35-1.50	2.0-6.0	0.15-0.18	7.4-7.8	Low----------	0.20	5	3	2-5
Minneiska	11-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-7.8	Low----------	0.28			
471----------	0-12	5-18	1.25-1.45	0.6-2.0	0.20-0.24	6.6-7.8	Low----------	0.32	4	6	3-5
Root	12-60	5-18	1.35-1.60	>20	0.01-0.02	7.4-7.8	Low----------	----			

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
476B, 476C2, 476D----------	0-12	18-25	1.30-1.35	0.6-2.0	0.21-0.23	6.6-7.3	Moderate-----	0.32	4	6	2-3
Frankville	12-28	23-32	1.30-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43			
	28-35	40-55	1.50-1.70	0.06-0.2	0.12-0.15	6.1-7.3	High----------	0.32			
	35-48	40-55	1.50-1.70	0.06-0.2	0.12-0.15	6.1-7.3	Low-----------	0.32			
	48	---	---	---	---	---	----------	----			
477----------	0-39	22-27	1.20-1.40	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.32	5	6	3-4
Littleton	39-60	18-30	1.20-1.40	0.6-2.0	0.20-0.22	5.6-6.5	Low-----------	0.43			
484D----------	0-38	5-18	1.45-1.60	2.0-6.0	0.13-0.16	5.1-6.5	Low-----------	0.20	5	3	2-3
Eyota	38-60	5-18	1.50-1.60	2.0-6.0	0.12-0.14	4.5-6.0	Low-----------	0.20			
488G----------	0-12	5-18	1.15-1.30	0.6-2.0	0.06-0.12	6.6-7.8	Low-----------	0.20	2	8	2-5
Brodale	12-20	5-18	1.20-1.35	0.6-2.0	0.06-0.12	7.4-8.4	Low-----------	0.20			
	20-60	5-18	1.20-1.35	0.6-6.0	0.04-0.09	7.9-8.4	Low-----------	0.20			
492B, 492C--------	0-8	18-24	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	4-3	6	2-3
Nasset	8-45	26-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	45-54	40-55	1.60-1.80	0.06-0.2	0.12-0.15	6.6-7.8	High----------	0.32			
	54-60	40-55	1.60-1.80	0.06-0.2	0.12-0.15	6.6-7.3	Low-----------	0.32			
500C2, 500D2------	0-14	15-27	1.35-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.37	2	6	2-3
Edmund	14-20	40-60	1.40-1.65	0.2-0.6	0.09-0.13	5.6-7.3	High----------	0.37			
	20-36	40-60	1.40-1.65	0.2-0.6	0.09-0.13	6.6-7.8	Low-----------	0.37			
	36	---	---	---	---	---	----------	----			
518----------	0-10	27-32	1.30-1.45	0.6-2.0	0.20-0.24	6.6-7.8	Moderate-----	0.28	5	6	3-5
Kalmarville	10-27	8-18	1.40-1.50	2.0-6.0	0.13-0.18	6.6-7.8	Low-----------	0.20			
	27-60	2-5	1.55-1.65	6.0-20	0.06-0.09	7.3-7.8	Low-----------	0.10			
522----------	0-60	---	0.16-0.28	0.6-6.0	0.35-0.45	6.6-7.3	----------	----	---	3	60-80
Boots											
576, 577, 578----	0-3	10-18	1.35-1.50	0.6-2.0	0.20-0.24	6.1-7.3	Low-----------	0.32	5	5	1-3
Newalbin	3-57	10-18	1.35-1.50	0.6-2.0	0.17-0.22	6.1-7.3	Low-----------	0.32			
	57-60	10-35	1.35-1.50	0.6-2.0	0.17-0.22	6.1-7.3	Low-----------	0.32			
580B*, 580C2*, 580D2*:											
Blackhammer----	0-10	8-23	1.40-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.37	3	6	1-3
	10-27	18-27	1.45-1.55	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.37			
	27-60	18-35	1.35-1.65	0.6-2.0	0.08-0.16	5.1-6.0	Moderate-----	0.28			
Southridge-----	0-8	8-17	1.40-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.43	3	5	2-3
	8-33	10-30	1.45-1.55	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.43			
	33-60	55-80	1.50-1.65	0.06-0.2	0.09-0.13	4.5-6.0	Moderate-----	0.28			
584F*:											
Lamoille--------	0-13	12-27	1.25-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.43	3	6	1-3
	13-27	35-55	1.40-1.60	0.06-0.6	0.12-0.16	5.1-6.0	Moderate-----	0.43			
	27-37	25-45	1.30-1.50	0.2-0.6	0.07-0.16	5.6-7.3	Moderate-----	0.32			
	37-60	8-27	1.30-1.50	2.0-6.0	0.06-0.12	7.4-8.4	Low-----------	0.32			
Dorerton--------	0-6	10-18	1.30-1.40	0.6-2.0	0.20-0.24	5.1-7.3	Low-----------	0.32	2	5	1-2
	6-11	18-35	1.30-1.45	0.6-2.0	0.17-0.19	5.1-6.0	Low-----------	0.32			
	11-25	20-35	1.20-1.45	0.6-2.0	0.08-0.14	5.6-7.3	Low-----------	0.24			
	25-60	2-25	1.20-1.45	2.0-6.0	0.03-0.09	7.4-8.4	Low-----------	0.10			
585C*, 585D*:											
Newhouse--------	0-9	12-23	1.30-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.37	3	6	3-4
	9-25	18-30	1.45-1.60	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.37			
	25-60	18-35	1.40-1.75	0.6-2.0	0.08-0.16	5.1-6.0	Moderate-----	0.28			
Valton----------	0-9	10-20	1.25-1.35	0.6-2.0	0.22-0.24	5.1-7.3	Low-----------	0.37	4	5	1-3
	9-33	18-35	1.40-1.55	0.6-2.0	0.18-0.22	5.1-6.5	Moderate-----	0.37			
	33-60	40-80	1.40-1.55	0.06-0.2	0.09-0.12	4.5-6.0	High----------	0.20			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
586C2*, 586D2*:											
Nodine	0-7	12-23	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.43	3	6	1-3
	7-10	15-27	1.35-1.50	0.6-2.0	0.22-0.24	5.1-6.5	Low	0.43			
	10-60	18-35	1.35-1.65	0.6-2.0	0.08-0.16	5.1-6.0	Moderate	0.28			
Rollingstone	0-6	12-25	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.43	3	6	1-3
	6-13	15-27	1.35-1.50	0.6-2.0	0.22-0.24	5.1-6.5	Low	0.43			
	13-60	60-80	1.45-1.65	0.06-0.2	0.09-0.14	4.5-5.5	Moderate	0.28			
592E*:											
Lamoille	0-13	12-27	1.25-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.43	3	6	1-3
	13-27	35-55	1.40-1.60	0.06-0.6	0.12-0.16	5.1-6.0	Moderate	0.43			
	27-37	25-45	1.30-1.50	0.2-0.6	0.07-0.16	5.6-7.3	Moderate	0.32			
	37-60	8-27	1.30-1.50	2.0-6.0	0.06-0.12	7.4-8.4	Low	0.32			
Elbaville	0-12	10-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.32	4	5	1-2
	12-22	24-35	1.35-1.50	0.2-0.6	0.16-0.19	5.1-7.3	Moderate	0.32			
	22-31	35-50	1.25-1.35	0.2-0.6	0.13-0.16	5.6-7.3	Moderate	0.32			
	31-60	20-35	1.35-1.50	0.6-2.0	0.12-0.14	6.6-7.8	Moderate	0.24			
593F	0-12	10-27	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.32	4	5	1-2
Elbaville	12-22	24-35	1.35-1.50	0.2-0.6	0.16-0.19	5.1-7.3	Moderate	0.32			
	22-31	35-50	1.25-1.35	0.2-0.6	0.13-0.16	5.6-7.3	Moderate	0.32			
	31-60	20-35	1.35-1.50	0.6-2.0	0.12-0.14	6.6-7.8	Moderate	0.24			
598B*:											
Beavercreek	0-5	5-18	1.40-1.50	2.0-6.0	0.15-0.20	6.1-7.3	Low	0.17	3	8	1-2
	5-12	5-18	1.40-1.50	2.0-6.0	0.14-0.18	6.1-7.3	Low	0.17			
	12-60	5-18	1.40-1.50	2.0-6.0	0.04-0.08	6.6-7.8	Low	0.17			
Arenzville	0-32	10-18	1.20-1.55	0.6-2.0	0.20-0.24	6.6-7.8	Low	0.37	5	5	1-3
	32-46	10-30	1.25-1.45	0.6-2.0	0.18-0.22	6.6-7.8	Moderate	0.37			
	46-60	5-20	1.20-1.40	0.6-2.0	0.12-0.16	5.6-7.8	Low	0.37			
599E2, 599F	0-5	7-18	1.35-1.50	0.6-2.0	0.20-0.24	5.1-6.5	Low	0.32	4	5	1-2
Norden	5-23	18-30	1.45-1.55	0.6-2.0	0.15-0.20	5.1-6.5	Moderate	0.32			
	23-30	6-25	1.45-1.55	0.6-2.0	0.09-0.19	4.5-7.3	Low	0.32			
	30-47	---	---	---	---	---	---	---			
	47	---	---	---	---	---	---	---			
601D2, 601E	0-7	6-10	1.35-1.60	0.6-2.0	0.11-0.22	4.5-6.5	Low	0.24	5	3	.5-2
Council	7-23	10-18	1.55-1.65	0.6-2.0	0.14-0.22	4.5-6.5	Low	0.32			
	23-54	8-18	1.55-1.65	0.6-2.0	0.14-0.22	5.1-6.5	Low	0.32			
	54-60	10-18	1.55-1.65	0.6-2.0	0.14-0.22	5.1-7.3	Low	0.32			
604*:											
Huntsville	0-33	18-27	1.15-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Moderate	0.28	5	6	3-4
	33-60	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate	0.28			
Beavercreek	0-5	10-18	1.30-1.45	2.0-6.0	0.20-0.22	6.1-7.8	Low	0.24	3	5	2-3
	5-12	5-18	1.40-1.50	2.0-6.0	0.14-0.18	6.1-7.8	Low	0.17			
	12-60	5-18	1.40-1.50	2.0-6.0	0.04-0.08	6.6-7.8	Low	0.17			
605D2	0-7	14-17	1.35-1.55	0.6-2.0	0.22-0.24	4.5-7.3	Low	0.37	4	5	1-3
La Farge	7-33	20-30	1.35-1.75	0.6-2.0	0.18-0.22	4.5-6.5	Moderate	0.37			
	33-43	6-30	1.55-1.70	0.6-2.0	0.15-0.19	4.5-6.5	Moderate	0.37			
	43	---	---	---	---	---	---	---			
606	0-16	35-46	1.30-1.50	0.2-0.6	0.12-0.21	6.1-7.3	High	0.28	3	4	4-6
Shiloh	16-60	35-46	1.35-1.55	0.06-0.2	0.09-0.18	6.6-7.8	High	0.28			
608	0-9	18-27	1.25-1.35	0.6-2.0	0.21-0.23	7.4-8.4	Moderate	0.32	5	4L	1-3
Rawles	9-60	22-32	1.35-1.40	0.6-2.0	0.19-0.21	7.4-8.4	Moderate	0.32			
879B*:											
Newalbin	0-3	10-18	1.35-1.50	0.6-2.0	0.20-0.24	6.1-7.3	Low	0.32	5	5	1-3
	3-43	10-18	1.35-1.50	0.6-2.0	0.17-0.22	6.1-7.3	Low	0.32			
	43-60	---	0.10-0.30	0.2-0.6	0>30-0.48	6.1-7.3	Low	---			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
879B*:											
Palms	0-35	---	0.25-0.45	0.6-2.0	0.35-0.45	6.1-7.8			2	3	>75
	35-60	7-35	1.45-1.75	0.6-2.0	0.14-0.22	6.1-7.8	Low				
1010*.											
Riverwash											
1013*.											
Pits											
1016.											
Udorthents											
1812	0-8	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.32	5	6	4-5
Terril	8-46	22-30	1.40-1.65	0.6-2.0	0.16-0.18	6.1-7.3	Low	0.32			
	46-60	2-8	1.65-1.75	6.0-20	0.05-0.07	6.1-8.4	Low	0.10			
1822B	0-3	3-10	1.45-1.65	2.0-20	0.07-0.10	6.6-7.8	Low	0.15	3	1	.5-1
Abscota Variant	3-60	3-10	1.45-1.65	2.0-20	0.07-0.10	6.6-7.8	Low	0.20			
1830	0-25	18-25	1.35-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.28	5	6	2-4
Eitzen	25-48	18-27	1.30-1.45	0.6-2.0	0.20-0.22	5.1-6.5	Low	0.28			
	48-60	18-27	1.40-1.65	0.6-2.0	0.18-0.20	5.1-6.0	Low	0.28			
1838	0-8	20-26	1.25-1.30	0.6-2.0	0.22-0.24	6.6-7.8	Moderate	0.28	5	6	3-5
Colo	8-40	30-35	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.8	High	0.28			
	40-60	30-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High	0.28			
1847	0-10	8-15	1.35-1.50	2.0-6.0	0.13-0.18	6.6-7.8	Low	0.20	5	3	2-4
Kalmarville	10-27	8-18	1.40-1.50	2.0-6.0	0.13-0.18	6.6-7.8	Low	0.20			
	27-60	2-5	1.55-1.65	6.0-20	0.06-0.09	6.6-7.8	Low	0.10			
1856D, 1856E	0-8	5-15	1.35-1.65	2.0-6.0	0.08-0.11	4.5-7.3	Low	0.17	5	2	.5-1
Plainfield	8-50	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low	0.17			
	50-60	15-27	1.60-1.70	0.6-2.0	0.13-0.18	5.1-8.4	Low	0.32			
1857B	0-25	18-25	1.35-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.28	5	6	2-4
Eitzen	25-48	18-27	1.30-1.45	0.6-2.0	0.20-0.22	5.1-6.5	Low	0.28			
	48-60	18-27	1.40-1.65	0.6-2.0	0.18-0.20	5.1-6.0	Low	0.28			
1858F*:											
Timula	0-60	10-18	1.30-1.60	0.6-2.0	0.20-0.24	6.1-3.4	Low	0.37	5-4	5	1-2
Lamont	0-9	10-15	1.50-1.55	2.0-6.0	0.16-0.18	5.1-7.3	Low	0.24	5	3	.5-1
	9-60	10-22	1.45-1.65	2.0-6.0	0.14-0.16	5.1-6.0	Low	0.24			
1860	0-8	28-35	1.20-1.40	0.6-2.0	0.18-0.22	6.6-7.8	Moderate	0.28	5	6	6-10
Comfrey	8-29	18-35	1.20-1.40	0.6-2.0	0.16-0.20	5.1-7.3	Moderate	0.28			
	29-60	18-35	1.30-1.50	0.6-2.0	0.15-0.19	6.6-8.4	Moderate	0.28			
1861B	0-7	12-16	1.35-1.55	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.37	5	5	2-3
Chaseburg	7-60	10-18	1.55-1.65	0.6-2.0	0.20-0.22	5.6-6.5	Low	0.37			
1862	0-6	35-50	1.20-1.30	0.2-0.6	0.15-0.18	5.1-7.3	Moderate	0.32	3	4	1-2
Zwingle Variant	6-47	60-75	1.20-1.40	<0.06	0.10-0.14	4.5-6.0	High	0.32			
	47-60	25-50	1.20-1.30	0.06-0.2	0.15-0.18	5.6-7.8	Moderate	0.43			
1885	0-8	2-15	1.20-1.60	6.0-20	0.08-0.12	6.1-7.3	Low	0.17	5	2	.5-3
Abscota	8-60	0-10	1.25-1.60	6.0-20	0.05-0.11	6.6-7.8	Low	0.17			
1886	0-9	2-8	1.45-1.60	6.0-20	0.06-0.10	7.4-7.8	Low	0.17	5	2	.5-2
Minneiska Variant	9-29	2-5	1.40-1.60	2.0-20	0.05-0.10	7.4-7.8	Low	0.17			
	29-60	12-25	1.35-1.50	2.0-6.0	0.14-0.20	6.6-7.8	Low	0.17			
1888, 1889	0-10	28-35	1.30-1.40	0.6-2.0	0.18-0.22	7.4-7.8	Moderate	0.32	5	4L	2-3
Moundprairie	10-40	18-35	1.35-1.45	0.6-2.0	0.18-0.22	7.4-7.8	Moderate	0.32			
	40-60	15-35	1.35-1.50	0.6-2.0	0.16-0.22	6.6-7.8	Moderate	0.32			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
1890----------	0-9	20-26	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	6	2-3
Walford	9-18	18-26	1.35-1.40	0.6-2.0	0.20-0.22	5.1-6.0	Low----------	0.43			
	18-34	27-35	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43			
	34-60	24-27	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.8	Moderate-----	0.43			
1893C----------	0-15	12-18	1.45-1.55	0.6-2.0	0.18-0.22	6.1-7.3	Low----------	0.28	3	5	3-5
Beavercreek	15-23	12-18	1.40-1.50	0.6-2.0	0.15-0.17	6.1-7.3	Low----------	0.28			
Variant	23-60	8-16	1.40-1.50	2.0-6.0	0.06-0.12	6.6-7.8	Low----------	0.20			
1898F*:											
Etter----------	0-8	8-15	1.30-1.50	2.0-6.0	0.16-0.18	5.6-7.3	Low----------	0.20	4	3	1-2
	8-17	10-18	1.35-1.55	0.6-2.0	0.17-0.19	4.5-6.5	Low----------	0.20			
	17-22	2-8	1.50-1.70	6.0-20	0.08-0.10	4.5-6.0	Low----------	0.20			
	22-60	1-5	1.50-1.70	6.0-20	0.05-0.07	4.5-6.0	Low----------	0.15			
Brodale---------	0-12	5-18	1.15-1.30	0.6-2.0	0.06-0.12	6.6-8.4	Low----------	0.20	2	8	2-5
	12-40	5-18	1.20-1.35	0.6-6.0	0.04-0.09	7.4-7.8	Low----------	0.20			
	40	---	---	---	---	---	----------	----			
1906D----------	0-25	18-24	1.20-1.30	0.6-2.0	0.22-0.26	5.6-7.3	Low----------	0.32	5	5	3-5
Lindstrom	25-60	18-24	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.43			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
8A---------- Sparta	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
11C---------- Sogn	D	None--------	---	---	>6.0	---	---	4-20	Hard	Moderate	Low------	Low.
16---------- Arenzville	B	Occasional	Brief-----	Nov-Jun	3.0-6.0	Apparent	Nov-Jun	>60	---	High-----	Moderate	Moderate.
18---------- Comfrey	B/D	Occasional	Brief to long.	Apr-Jul	1.0-3.0	Apparent	Apr-Jul	>60	---	High-----	High-----	Low.
25---------- Becker	B	Rare--------	---	---	>4.0	Apparent	Nov-May	>60	---	Moderate	Low------	Low.
27B---------- Dickinson	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
76A, 76B---------- Bertrand	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
79B, 79C---------- Billett	A	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
81F---------- Boone	A	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Low------	Moderate.
103A, 103B, 103C2, 103D2---------- Seaton	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
131B, 131C-------- Massbach	B	None--------	---	---	3.0-5.0	Perched	Feb-Jun	40-60	Soft	High-----	High-----	Moderate.
136---------- Madelia	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
143E2, 143F------- Eleva	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Low------	Moderate.
177B---------- Gotham	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
194---------- Huntsville	B	Occasional	Brief-----	Apr-Jun	>6.0	---	---	>60	---	High-----	Low------	Low.
216B---------- Lamont	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
244B---------- Lilah	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
250---------- Kennebec	B	Occasional	Brief-----	Feb-Nov	2.0-5.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Low.
273---------- Muscatine	B	None--------	---	---	2.0-5.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
283B, 283C, 283D, 283F---------- Plainfield	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
285A, 285B, 285C-- Port Byron	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
298---------- Richwood	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
301B, 301C-------- Lindstrom	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
312B, 312C-------- Shullsburg	C	None--------	---	---	1.0-3.0	Perched	Nov-May	20-40	Soft	High-----	Moderate	Low.
322D2, 322E------- Timula	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
388C2, 388D2, 388E, 388F------- Seaton	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
401B, 401C, 401D-- Mt. Carroll	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
455A, 455B, 455C2- Festina	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
457E, 457G-------- Lacrescent	B	None--------	---	---	>6.0	---	---	>40	Hard	Moderate	Low------	Low.
463---------- Minneiska	B	Occasional	Brief-----	Mar-Jul	4.0-6.0	Apparent	Mar-Jun	>60	---	Moderate	Low------	Low.
471---------- Root	B/D	Frequent----	Very brief	Mar-Jun	0-2.0	Apparent	Jan-Dec	>60	---	High-----	High-----	Low.
476B, 476C2, 476D- Frankville	B	None--------	---	---	>6.0	---	---	40-80	Hard	High-----	Moderate	Moderate.
477---------- Littleton	B	None--------	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High-----	High-----	Low.
484D---------- Eyota	A	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.
488G---------- Brodale	C	None--------	---	---	>6.0	---	---	40-80	Hard	Low------	Low------	Low.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
492B, 492C--------- Nasset	B	None---------	---	---	>6.0	---	---	>60	Hard	High-----	Moderate	Moderate.
500C2, 500D2------ Edmund	D	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
518---------- Kalmarville	B/D	Occasional	Brief-----	Mar-Jun	0-1.0	Apparent	Mar-Aug	>60	---	High-----	Moderate	Low.
522---------- Boots	A/D	Occasional	Long------	Nov-May	+1-1.0	Apparent	Nov-Aug	>60	---	High-----	Moderate	Low.
576, 577---------- Newalbin	B/D	Occasional	Very brief to brief.	Mar-Jul	1.0-3.0	Apparent	Mar-Jul	>60	---	High-----	High-----	Low.
578---------- Newalbin	D	Occasional	Brief-----	Mar-Jul	+1-2.0	Apparent	Jan-Dec	>60	---	High-----	High-----	Low.
580B*, 580C2*, 580D2*:												
Blackhammer-----	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	High.
Southridge------	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	High.
584F*:												
Lamoille---------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Dorerton---------	B	None---------	---	---	>6.0	---	---	40-80	Soft	Low------	Low------	Moderate.
585C*, 585D*:												
Newhouse---------	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	High.
Valton-----------	C	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	High.
586C2*, 586D2*:												
Nodine-----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	High.
Rollingstone-----	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	High.
592E*:												
Lamoille---------	B	None---------	---	---	>6.0	---	---	>40	---	Moderate	Low------	Moderate.
Elbaville--------	B	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
593F---------- Elbaville	B	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
598B*:												
Beavercreek------	B	Occasional	Very brief	Apr-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
Arenzville-------	B	Occasional	Brief-----	Nov-Jun	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
599E2, 599F------- Norden	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Low------	Moderate.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
601D2, 601E--Council	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
604*:												
Huntsville	B	Occasional	Brief	Apr-Jun	>6.0	---	---	>60	---	High	Low	Low.
Beavercreek	B	Occasional	Very brief	Apr-Jun	>6.0	---	---	>60	---	Low	Low	Low.
605D2--La Farge	B	None	---	---	>6.0	---	---	40-80	Soft	High	Moderate	Moderate.
606--Shiloh	B/D	Frequent	Brief	Mar-Jun	+1-2.0	Apparent	Mar-Jun	>60	---	High	High	Low.
608--Rawles	B	Occasional	Brief	Feb-Nov	>6.0	---	---	>60	---	High	Moderate	Low.
879B*:												
Newalbin	D	Occasional	Very brief	Mar-Jul	0-2.5	Apparent	Jan-Dec	>60	---	High	High	Low.
Palms	A/D	Occasional	Very brief	Mar-Jul	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
1010*. Riverwash												
1013*. Pits												
1016. Udorthents												
1812--Terril	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
1822B--Abscota Variant	A	Occasional	Very brief	Mar-Jun	3.0-6.0	Apparent	Mar-Jun	>60	---	Moderate	Moderate	Low.
1830--Eitzen	B	Occasional	Very brief	Apr-Nov	>6.0	---	---	>60	---	High	Low	Moderate.
1838--Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
1847--Kalmarville	B/D	Frequent	Brief	Mar-Jun	0-1.0	Apparent	Mar-Aug	>60	---	High	Moderate	Low.
1856D, 1856E--Plainfield	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
1857B--Eitzen	B	Occasional	Very brief	Apr-Nov	>6.0	---	---	>60	---	High	Low	Moderate.
1858F*:												
Timula	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1858F*: Lamont	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
1860--- Comfrey	B/D	Frequent	Brief to long.	Apr-Jul	1.0-3.0	Apparent	Apr-Jul	>60	---	High	High	Low.
1861B--- Chaseburg	B	Frequent	Very brief	Nov-Jun	>6.0	---	---	>60	---	High	Moderate	Moderate.
1862--- Zwingle Variant	D	None	---	---	2.0-4.0	Perched	Nov-Jul	>60	---	Moderate	High	Moderate.
1885--- Abscota	A	Occasional	Brief	Mar-Jun	2.0-5.0	Apparent	Dec-May	>60	---	Low	Low	Low.
1886--- Minneiska Variant	A	Occasional	Brief	Mar-Jun	3.0-6.0	Apparent	Mar-Jun	>60	---	Low	Low	Low.
1888--- Moundprairie	B/D	Occasional	Brief	Mar-Jun	1.0-3.0	Apparent	Mar-Nov	>60	---	High	High	Low.
1889--- Moundprairie	D	Occasional	Brief	Mar-Jun	+1-1.0	Apparent	Jan-Dec	>60	---	High	High	Low.
1890--- Walford	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
1893C--- Beavercreek Variant	B	Occasional	Very brief	Mar-Jun	>6.0	---	---	>60	---	Low	Low	Moderate.
1898F*: Etter	B	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
Brodale	C	None	---	---	>6.0	---	---	40-80	Hard	Low	Low	Low.
1906D--- Lindstrom	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Abscota	Mixed, mesic Typic Udipsamments
Abscota Variant	Sandy mixed, mesic Typic Udifluvents
Arenzville	Coarse-silty, mixed, nonacid, mesic Typic Udifluvents
Beavercreek	Loamy-skeletal, mixed, nonacid, mesic Typic Udifluvents
Beavercreek Variant	Coarse-loamy, mixed, nonacid, mesic Typic Udifluvents
Becker	Coarse-loamy, mixed, mesic Typic Hapludolls
*Bertrand	Fine-silty, mixed, mesic Typic Hapludalfs
Billett	Coarse-loamy, mixed, mesic Mollic Hapludalfs
Blackhammer	Fine-silty, mixed, mesic Typic Hapludalfs
Boone	Mesic, uncoated Typic Quartzipsamments
Boots	Euic, mesic Typic Medihemists
Brodale	Loamy-skeletal, carbonatic, mesic Entic Hapludolls
Chaseburg	Coarse-silty, mixed, nonacid, mesic Typic Udifluvents
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Comfrey	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Council	Coarse-loamy, mixed, mesic Typic Hapludalfs
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Dorerton	Loamy-skeletal, mixed, mesic Typic Hapludalfs
*Edmund	Clayey, montmorillonitic, mesic Lithic Argiudolls
Eitzen	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Elbaville	Fine-loamy, mixed, mesic Glossoboric Hapludalfs
*Eleva	Coarse-loamy, mixed, mesic Typic Hapludalfs
Etter	Coarse-loamy, mixed, mesic Typic Hapludolls
Eyota	Coarse-loamy, mixed, mesic Cumulic Hapludolls
Festina	Fine-silty, mixed, mesic Mollic Hapludalfs
*Frankville	Fine-silty, mixed, mesic Mollic Hapludalfs
Gotham	Sandy, mixed, mesic Psammentic Hapludalfs
Huntsville	Fine-silty, mixed, mesic Cumulic Hapludolls
*Kalmarville	Coarse-loamy, mixed, nonacid, mesic Mollic Fluvaquents
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
*La Farge	Fine-silty, mixed, mesic Typic Hapludalfs
Lacrescent	Loamy-skeletal, mixed, mesic Typic Hapludolls
Lamoille	Fine, mixed, mesic Typic Hapludalfs
Lamont	Coarse-loamy, mixed, mesic Typic Hapludalfs
Lilah	Sandy, mixed, mesic Psammentic Hapludalfs
Lindstrom	Fine-silty, mixed, mesic Cumulic Hapludolls
Littleton	Fine-silty, mixed, mesic Cumulic Hapludolls
Madelia	Fine-silty, mixed, mesic Typic Haplaquolls
Massbach	Fine-silty, mixed, mesic Mollic Hapludalfs
Minneiska	Coarse-loamy, mixed (calcareous), mesic Mollic Udifluvents
Minneiska Variant	Sandy over loamy, mixed (calcareous), mesic Mollic Udifluvents
Moundprairie	Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents
Mt. Carroll	Fine-silty, mixed, mesic Mollic Hapludalfs
Muscatine	Fine-silty, mixed, mesic Aquic Hapludolls
*Nasset	Fine-silty, mixed, mesic Mollic Hapludalfs
Newalbin	Coarse-silty, mixed, nonacid, mesic Typic Fluvaquents
Newhouse	Fine-silty, mixed, mesic Mollic Hapludalfs
Nodine	Fine-loamy, mixed, mesic Typic Hapludalfs
Norden	Fine-loamy, mixed, mesic Typic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Plainfield	Mixed, mesic Typic Udipsamments
Port Byron	Fine-silty, mixed, mesic Typic Hapludolls
Rawles	Fine-silty, mixed (calcareous), mesic Mollic Udifluvents
Richwood	Fine-silty, mixed, mesic Typic Argiudolls
Rollingstone	Very-fine, mixed, mesic Typic Paleudalfs
*Root	Coarse-loamy, mixed, nonacid, mesic Mollic Fluvaquents
Seaton	Fine-silty, mixed, mesic Typic Hapludalfs
Shiloh	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Shullsburg	Fine, mixed, mesic Aquic Argiudolls
*Sogn	Loamy, mixed, mesic Lithic Haplustolls
Southridge	Fine-silty over clayey, mixed, mesic Typic Paleudalfs
Sparta	Sandy, mixed, mesic Entic Hapludolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Timula	Coarse-silty, mixed, mesic Typic Eutrochrepts
Udorthents	Loamy, mixed, mesic Udorthents
Valton	Fine-silty mixed, mesic Mollic Paleudalfs
Walford	Fine-silty, mixed, mesic Mollic Ochraqualfs
Zwingle Variant	Very fine, montmorillonitic, mesic Typic Ochraqualfs

*The soil is a taxadjunct to the series. See text for description of those characteristics of the soil that are outside the range of the series.

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91°40′ 91°30′ 91°20′ 43°50′ 43°40′ 43°30′

WINONA COUNTY — LA CROSSE COUNTY — WISCONSIN — VERNON COUNTY

FILLMORE COUNTY — HOUSTON COUNTY

WINNESHIEK COUNTY — ALLAMAKEE COUNTY — IOWA

T 104 N — T 103 N — T 102 N — T 101 N

R 7 W — R 6 W — R 5 W — R 4 W — R 3 W

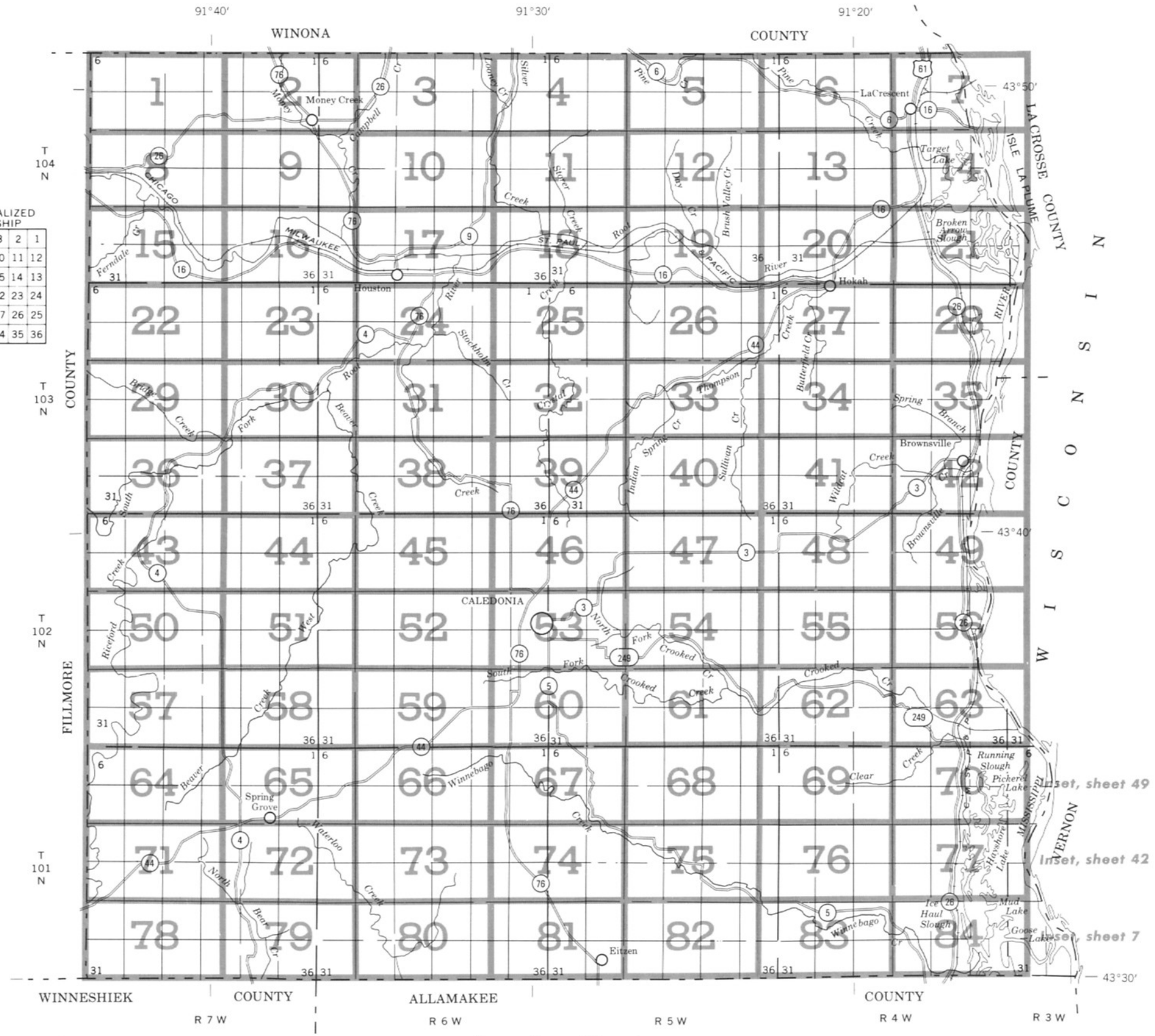
SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

N

Money Creek · Houston · Hokah · La Crescent · Target Lake · Broken Arrow Slough · Brownsville · Running Slough · Pickerel Lake · Howard Lake · Mud Lake · Goose Lake · Ice Hole Slough · CALEDONIA · Spring Grove · Eitzen

Money Creek · Campbell Cr · Mississippi · Silver Creek · Pine Creek · Duschee Cr · Slippy Creek · Roor · Brush Valley Cr · Dugout Cr · Butterfield Cr · Thompson Creek · Spring Branch · Sullivan Creek · Spring Cr · Wildcat Creek · Goldsmith Cr · Bridge Creek · Beaver Creek · Crooked Creek · Clear Creek · Winnebago Creek · Waterloo Creek · Bear Creek · Rush Creek · Pine Creek · Ferndale Cr · Spring Valley Creek · Dugout Creek · Bluff Siding Cr · Crystal Creek · Pine Creek · Fork · South Fork · North Fork · West Fork · Bear Cr · Crooked Creek · Clear Creek · Winnebago Creek · Waterloo Creek · Beaver



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

HOUSTON COUNTY, MINNESOTA

Scale 1:190,080

1 0 1 2 3 4 Miles

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A number 2 following the letter for slope indicates the soil is eroded.

SYMBOL	NAME
8A	Sparta loamy sand, 0 to 6 percent slopes
11C	Sogn silt loam, 2 to 12 percent slopes
16	Arenzville silt loam
18	Comfrey silt loam, occasionally flooded
25	Becker sandy loam
27B	Dickinson sandy loam, 1 to 6 percent slopes
76A	Bertrand silt loam, 0 to 2 percent slopes
76B	Bertrand silt loam, 2 to 6 percent slopes
79B	Billett sandy loam, 1 to 6 percent slopes
79C	Billett sandy loam, 6 to 12 percent slopes
81F	Boone sand, rocky, 20 to 70 percent slopes
103A	Seaton silt loam, 1 to 3 percent slopes
103B	Seaton silt loam, 3 to 6 percent slopes
103C2	Seaton silt loam, 6 to 12 percent slopes, eroded
103D2	Seaton silt loam, 12 to 20 percent slopes, eroded
131B	Massbach silt loam, 3 to 6 percent slopes
131C	Massbach silt loam, 6 to 12 percent slopes
136	Madelia silt loam
143E2	Eleva loam, 20 to 30 percent slopes, eroded
143F	Eleva sandy loam, 30 to 45 percent slopes
177B	Gotham loamy sand, 2 to 10 percent slopes
194	Huntsville silt loam, occasionally flooded
216B	Lamont fine sandy loam, 1 to 6 percent slopes
244B	Lilah sandy loam, 2 to 6 percent slopes
250	Kennebec silt loam, occasionally flooded
273	Muscatine silt loam
283B	Plainfield sand, 0 to 6 percent slopes
283C	Plainfield sand, 6 to 12 percent slopes
283D	Plainfield sand, 12 to 25 percent slopes
283F	Plainfield sand, 25 to 50 percent slopes
285A	Port Byron silt loam, 1 to 3 percent slopes
285B	Port Byron silt loam, 3 to 6 percent slopes
285C	Port Byron silt loam, 6 to 12 percent slopes
298	Richwood silt loam
301B	Lindstrom silt loam, 1 to 6 percent slopes
301C	Lindstrom silt loam, 6 to 12 percent slopes
312B	Shullsburg silt loam, 1 to 6 percent slopes
312C	Shullsburg silt loam, 6 to 12 percent slopes
322D2	Timula silt loam, 12 to 20 percent slopes, eroded
322E	Timula silt loam, 20 to 40 percent slopes
388C2	Seaton silt loam, valleys, 6 to 12 percent slopes, eroded
388D2	Seaton silt loam, valleys, 12 to 20 percent slopes, eroded
388E	Seaton loam, valleys, 20 to 30 percent slopes
388F	Seaton loam, valleys, 30 to 45 percent slopes
401B	Mt. Carroll silt loam, 3 to 6 percent slopes
401C	Mt. Carroll silt loam, 6 to 12 percent slopes
401D	Mt. Carroll silt loam, 12 to 20 percent slopes
455A	Festina silt loam, 0 to 2 percent slopes
455B	Festina silt loam, 2 to 6 percent slopes
455C2	Festina silt loam, 6 to 12 percent slopes, eroded
457E	Lacrescent flaggy silt loam, 20 to 35 percent slopes
457G	Lacrescent cobbly silty clay loam, 45 to 70 percent slopes
463	Minneiska fine sandy loam, occasionally flooded
471	Root silt loam
476B	Frankville silt loam, 3 to 6 percent slopes
476C2	Frankville silt loam, 6 to 12 percent slopes, eroded
476D	Frankville silt loam, 12 to 20 percent slopes
477	Littleton silt loam
484D	Eyota sandy loam, 12 to 20 percent slopes
488G	Brodale cobbly fine sandy loam, rocky, 45 to 70 percent slopes
492B	Nasset silt loam, 3 to 6 percent slopes
492C	Nasset silt loam, 6 to 12 percent slopes
500C2	Edmund silt loam, 4 to 12 percent slopes, eroded
500D2	Edmund silt loam, 12 to 20 percent slopes, eroded
518	Kalmarville silty clay loam, occasionally flooded
522	Boots mucky peat
576	Newalbin silt loam
577	Newalbin silt loam, channeled
578	Newalbin silt loam, depressional
580B	Blackhammer-Southridge silt loams, 3 to 6 percent slopes
580C2	Blackhammer-Southridge silt loams, 6 to 12 percent slopes, eroded
580D2	Blackhammer-Southridge silt loams, 12 to 20 percent slopes, eroded
584F	Lamoille-Dorerton silt loams, 30 to 45 percent slopes
585C	Newhouse-Valton silt loams, 6 to 12 percent slopes
585D	Newhouse-Valton silt loams, 12 to 20 percent slopes
586C2	Nodine-Rollingstone silt loams, 4 to 12 percent slopes, eroded
586D2	Nodine-Rollingstone silt loams, 12 to 20 percent slopes, eroded
592E	Lamoille-Elbaville silt loams, 20 to 30 percent slopes
593F	Elbaville silt loam, 30 to 45 percent slopes
598B	Beavercreek-Arenzville complex, 1 to 12 percent slopes
599E2	Norden silt loam, 15 to 30 percent slopes, eroded
599F	Norden silt loam, 30 to 45 percent slopes
601D2	Council fine sandy loam, 12 to 20 percent slopes, eroded
601E	Council sandy loam, 20 to 30 percent slopes
604	Huntsville-Beavercreek silt loams, channeled
605D2	La Farge silt loam, 12 to 20 percent slopes, eroded
606	Shiloh silty clay, ponded
608	Rawles silt loam, occasionally flooded
879B	Newalbin-Palms complex, 2 to 8 percent slopes
1010	Riverwash
1013	Pits, quarries
1016	Udorthents, loamy
1812	Terril loam, sandy substratum
1822B	Abscota Variant sand, 2 to 6 percent slopes
1830	Eitzen silt loam, occasionally flooded
1838	Colo silt loam, overwash
1847	Kalmarville fine sandy loam, channeled
1856D	Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes
1856E	Plainfield loamy fine sand, loamy substratum, 25 to 50 percent slopes
1857B	Eitzen silt loam, 1 to 6 percent slopes, channeled
1858F	Timula-Lamont complex, 40 to 70 percent slopes
1860	Comfrey silty clay loam, channeled
1861B	Chaseburg silt loam, 2 to 6 percent slopes, channeled
1862	Zwingle Variant silty clay
1885	Abscota loamy sand, occasionally flooded
1886	Minneiska Variant loamy fine sand
1888	Moundprairie silty clay loam, occasionally flooded
1889	Moundprairie silty clay loam, depressional
1890	Walford silt loam
1893C	Beavercreek Variant silt loam, 3 to 8 percent slopes
1898F	Etter-Brodale complex, rocky, 25 to 50 percent slopes
1906D	Lindstrom loam, 12 to 20 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

National, state or province

County or parish

Field sheet matchline & neatline

AD HOC BOUNDARY (label)

Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip

STATE COORDINATE TICK — 230 000 FEET

LAND DIVISION CORNERS (sections and land grants)

ROADS

Divided (median shown if scale permits)

Other roads

ROAD EMBLEMS & DESIGNATIONS

Federal — 61

State — 44

County, — 22

RAILROAD

DAMS

Large (to scale)

Medium or small — water

PITS

Gravel pit

Mine or quarry

WATER FEATURES

DRAINAGE

Perennial, double line

Perennial, single line

Intermittent

Drainage end

LAKES, PONDS AND RESERVOIRS

Perennial — water

MISCELLANEOUS WATER FEATURES

Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 103B 580D2

ESCARPMENTS

Bedrock (points down slope)

Sinkhole

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 1

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 2

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 3

3

N

R. 6 W. | WINONA COUNTY

T. 104 N. | 315 000 FEET

2 640 000 FEET

310 000 FEET

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 10)

CAMPBELL VALLEY

Campbell Creek

Looney Creek

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 4

4

N

R. 6 W. | R. 5 W.

WINONA COUNTY

T. 104 N.

2 670 000 FEET

315 000 FEET

310 000 FEET

2 655 000 FEET

(Joins sheet 3)

(Joins sheet 5)

388D2 (Joins sheet 11)

LOONEY VALLEY

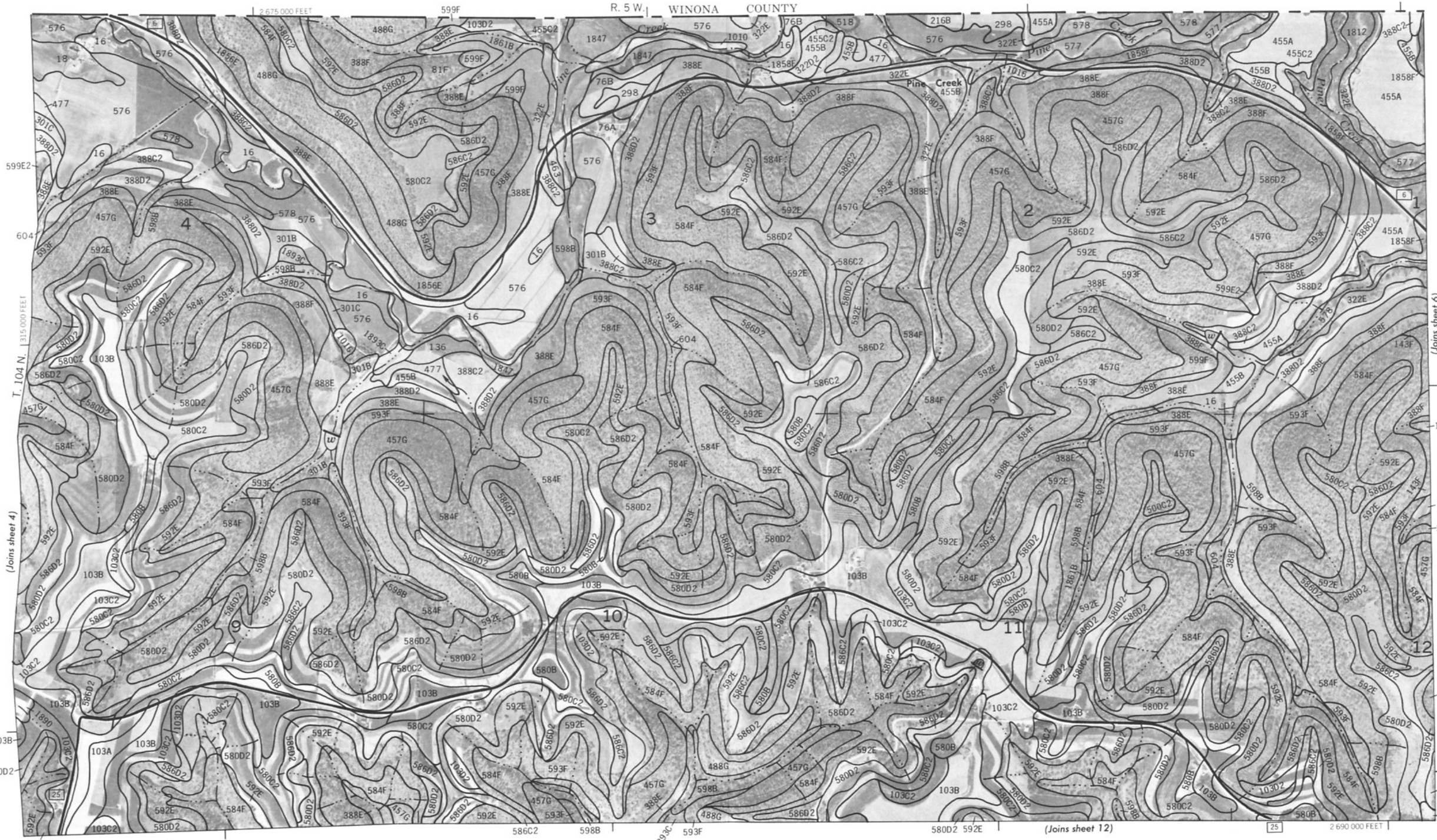
Looney Creek

Silver Creek

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 5

5

N



HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 6

N

R. 5 W. | R. 4 W.

WINONA COUNTY

2 705 000 FEET

320 000 FEET

310 000 FEET

2 695 000 FEET

T. 104 N.

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 13)

Pine Creek

VALLEY

BURNS

LA CRESCENT

1 2 3 4 5 6 7 8 9 10 11 12

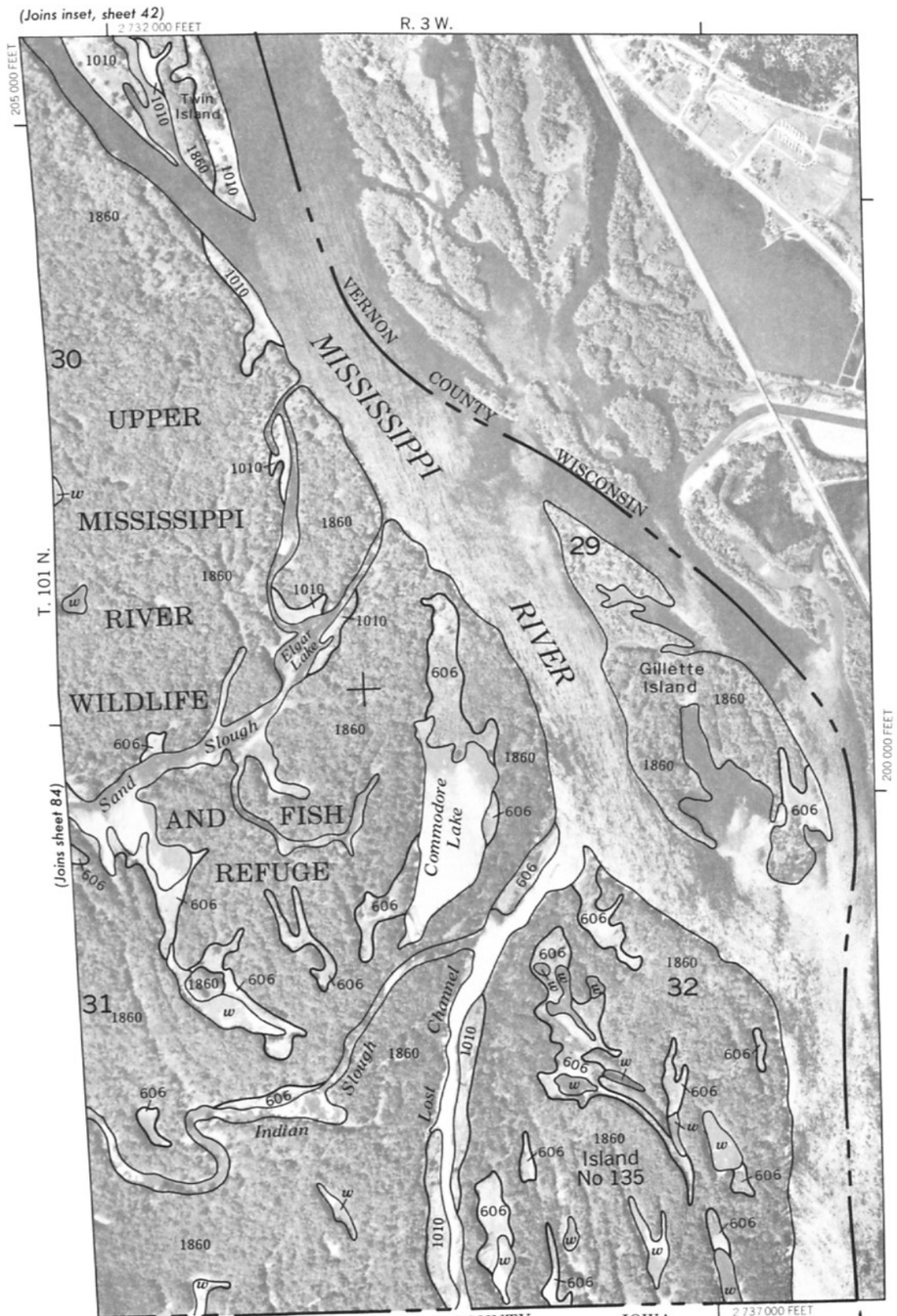
N

2 710 000 FEET
WINONA COUNTY
R. 4 W.
320 000 FEET
T. 104 N.
315 000 FEET
2 715 000 FEET
Minnesota Island
MISSISSIPPI RIVER
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
LA CROSSE MISSISSIPPI COUNTY RIVER
WISCONSIN
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC
LA CRESCENT
water
1860
1010
606
1016
1885
1886
(Joins sheet 6)
(Joins sheet 14)

MISSISSIPPI RIVER
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
WINONA COUNTY
WISCONSIN
Minnesota Island
Gilmore Island
Island No. 139
IOWA

N

Minnesota Island
MISSISSIPPI
RIVER
UPPER
MISSISSIPPI
RIVER
WILDLIFE
AND
FISH
REFUGE
LA CRESCENT
water
1860
1010
606
(Joins sheet 84)


(Joins inset, sheet 42)
2 732 000 FEET
R. 3 W.
205 000 FEET
Twin Island
1010
1860
606
VERNON COUNTY
WISCONSIN
MISSISSIPPI
RIVER
UPPER
MISSISSIPPI
RIVER
WILDLIFE
AND FISH
REFUGE
Elgar Lake
Sand Slough
Commodore Lake
Gillette Island
Island No 135
Indian Slough
Last Channel
30
29
31
32
T. 101 N.
(Joins sheet 84)
200 000 FEET
ALLAMAKEE COUNTY IOWA
2 737 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 8

(8)

N

R. 7 W.

T. 104 N.

FILLMORE COUNTY

2 615 000 FEET

2 600 000 FEET

305 000 FEET

300 000 FEET

(Joins sheet 1)

(Joins sheet 9)

(Joins sheet 15)

ROOT RIVER

water

Ferndale Creek

ROOT R.

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 9

9

N

R. 7 W. | R. 6 W.

(Joins sheet 2)

2 620 000 FEET

305 000 FEET

T. 104 N.

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 16)

300 000 FEET

2 635 000 FEET

CAMPBELL VALLEY Creek

Money Creek

15 14 13 18 22 23 24 19 4 16

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 10

(10)

N

R. 6 W.

2 650 000 FEET

305 000 FEET

300 000 FEET

T. 104 N.

(Joins sheet 3)

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 17)

Money Creek

Silver Creek

LOONEY VALLEY

17

16

15

14

20

21

22

23

18

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 11

11

N

R. 6 W. | R. 5 W.

T. 104 N.

2 655 000 FEET

305 000 FEET

300 000 FEET

2 670 000 FEET

(Joins sheet 4)

(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 18)

LOONEY VALLEY

Silver Cr.

Silver Creek

Silver Creek

13

14

17

18

19

20

23

24

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 12

12

N

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 13

13

N

R. 5 W. | R. 4 W.

2 695 000 FEET

(Joins sheet 6)

LA CRESCENT

Pine Creek

PFEFFER VALLEY

T. 104 N.

305 000 FEET

300 000 FEET

2 705 000 FEET

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 20)

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 14

14

N

R. 4 W. (Joins sheet 7)

2 725 000 FEET

310 000 FEET

T. 104 N.

LA CRESCENT

UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE

WINNEBAGO INDIAN RESERVATION

MISS. R.

LA CROSSE COUNTY

MISSISSIPPI RIVER

WISCONSIN

Pine Creek

CHICAGO MILWAUKEE ST PAUL AND PACIFIC

Target Lake

Broken Arrow Slough

21 22 23 24 13 14

(Joins sheet 13)

(Joins sheet 21)

1889 2 710 000 FEET 1888

300 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 15

15

N

2 600 000 FEET

R. 7 W.

(Joins sheet 8)

295 000 FEET

T. 104 N.

COUNTY

FILLMORE

ROOT

RIVER

(Joins sheet 16)

(Joins sheet 22)

2 615 000 FEET

290 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 16

16

N

R. 7 W. | R. 6 W.

2 635 000 FEET

76

T. 104 N.

(Joins sheet 9)

(Joins sheet 15)

(Joins sheet 17)

(Joins sheet 23)

2 620 000 FEET

290 000 FEET

295 000 FEET

1010

ROOT RIVER

Money Creek

Cushings Peak

27 26 25 30 34 35 36 31

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 17

17

N

R. 6 W.

2 640 000 FEET

295 000 FEET

290 000 FEET

T. 104 N.

(Joins sheet 10)

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 24)

2 650 000 FEET

ROOT RIVER

SOUTH FORK ROOT RIVER

HOUSTON

water

26

27

28

29

32

33

34

35

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 18

N

R. 5 W.

T. 104 N.

2 675 000 FEET

295 000 FEET

290 000 FEET

2 690 000 FEET

ROOT RIVER

Mound Prairie

Prairie Creek

Daw Creek

Bruss Valley Creek

ROOT R.

water

28

27

26

25

34

35

33

36

(Joins sheet 12)

(Joins sheet 20)

(Joins sheet 18)

(Joins sheet 26)

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 20

20

N

R. 5 W. | R. 4 W.

(Joins sheet 13)

(Joins sheet 19)

(Joins sheet 21)

(Joins sheet 27)

2 705 000 FEET

2 695 000 FEET

295 000 FEET

290 000 FEET

T. 104 N.

PFEFFER VALLEY

ROOT RIVER

Hokah

water

25 30 29 28 36 31 32 33

N

R. 4 W. | R. 3 W.

1889 | 2 710 000 FEET | 1860 (Joins sheet 14)

T. 104 N.

295 000 FEET

(Joins sheet 20)

322D2

290 000 FEET

484D (Joins sheet 28)

2 725 000 FEET

Target Lake

Broken Arrow Slough

LA CROSSE COUNTY WISCONSIN

MISSISSIPPI RIVER

UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE

ROOT RIVER

CHICAGO MILWAUKEE ST PAUL AND PACIFIC

26 27 25 30 35 34 36 31

22

N

R. 7 W.

2 615 000 FEET

T. 103 N.

FILLMORE COUNTY

2 600 000 FEET

275 000 FEET

285 000 FEET

(Joins sheet 15)

(Joins sheet 23)

(Joins sheet 29)

VALLEY

CRANSHOLM

OAK RIDGE

OAK RIDGE

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 23

23

N

R. 7 W. | R. 6 W.

T. 103 N.

OAK RIDGE

(Joins sheet 16)

(Joins sheet 22)

(Joins sheet 24)

(Joins sheet 30)

2 620 000 FEET

2 635 000 FEET

285 000 FEET

280 000 FEET

S. FORK ROOT R.

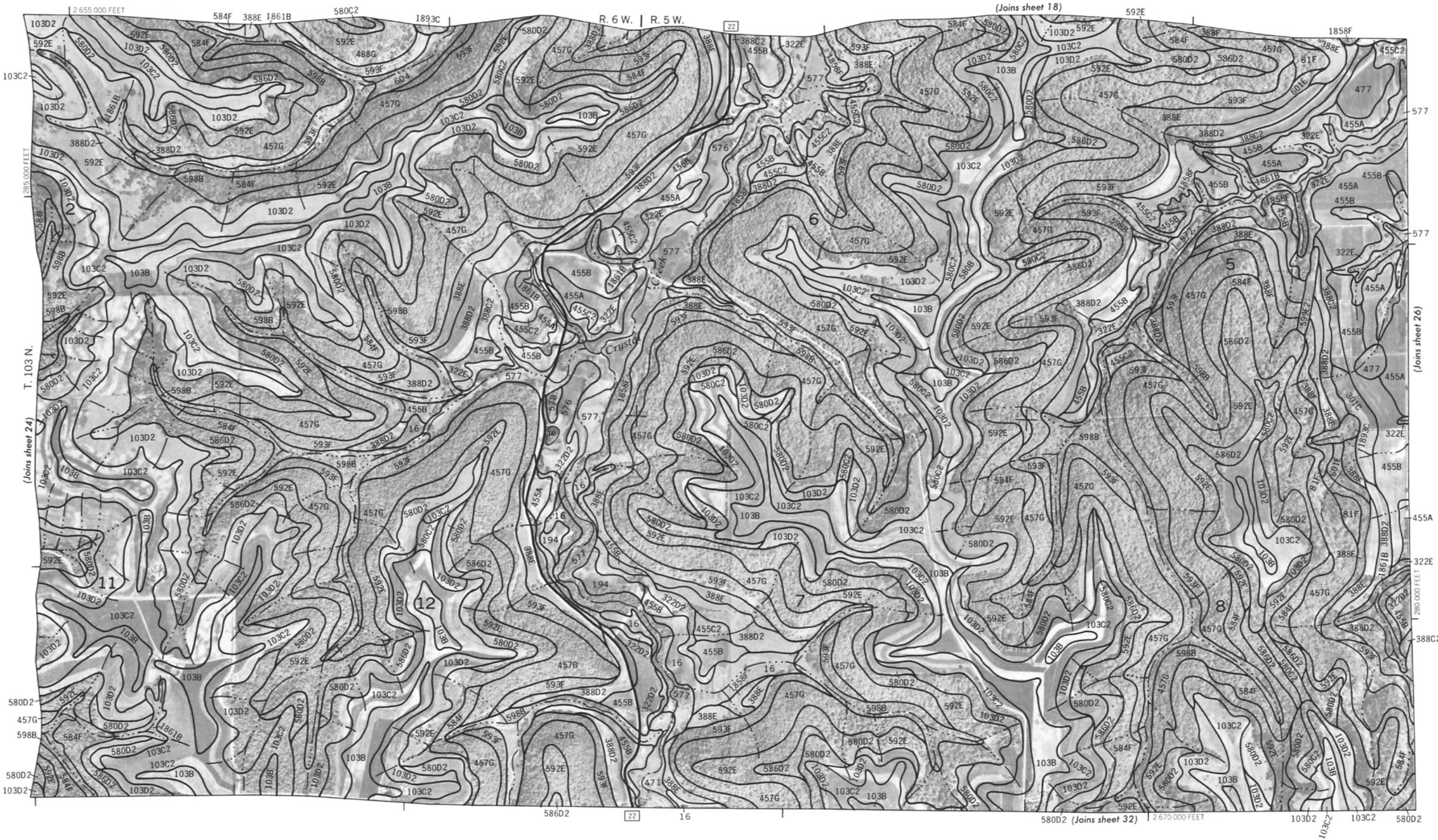
HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 24

(24)
N
(Joins sheet 17)
R. 6 W.
2 650 000 FEET
HOUSTON
SOUTH FORK ROOT RIVER
SWEDE BOTTOM
Swede Bottom Creek
Bradley Creek
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 31)
T. 103 N.
290 000 FEET
285 000 FEET
2 640 000 FEET
water
1822B
1812
1858F
322E
76B
1861B
283B
283C
283D
283F
388E
388D2
593F
457G
586D2
592E
455C2
455B
455A
1838
1889
250
18
16
25
8A
8
9
10
11
2
3
4
5
518
608
1885
1890
1862
1856E
1857B
216B
27B
79C
79B
599E2
605D2
601E
599F
580D2
580C2
584F
598B
103C2
103D2
103B
388C2
388D2
604
522
577
879B
1893C
1812B
1838B
1858F
1861B
1889
1890
1893C
1862
1856E
1857B
1885
1889
1890
1893C
1812B
1838B
1858F
1861B

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 25

25

N


R. 6 W.
R. 5 W.
T. 103 N.
2 655 000 FEET
2 670 000 FEET
285 000 FEET
280 000 FEET
(Joins sheet 18)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 32)
Crystal Creek
1
2
3
4
5
6
7
8
11
12
16
22
103D2
103C2
103B
580D2
592E
584F
598B
457G
593F
388D2
388E
455B
455A
322E
455C2
586D2
577
576
1858F
1861B
1893C
580C2
388C2
322D2
1858E
1861B
455C2
388F
1858F
455C2
455A
322E
455B
388D2
388E
322E
455A
455B
322E
455A
455B
388E
322E
455A
455B
388C2
322D2
455B
388C2
455A
322E
455B
388C2
580D2
457G
598B
584F
103D2
103C2
103B
592E
580D2
586D2
457G
593F
388D2
388E
455B
577
16
194
471
586D2
580D2
592E
103D2
103C2
103B
457G
593F
584F
598B
580D2
586

(26)

N

R. 5 W.

T. 103 N.

(Joins sheet 19)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 33)

2 690 000 FEET

2 675 000 FEET

285 000 FEET

280 000 FEET

ROOT RIVER

UNION RIDGE

Prairie Creek

Duschee Creek

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 27

27

N

ROOT RIVER

R. 5 W. | R. 4 W.

2 695 000 FEET

(Joins sheet 20)

(Joins sheet 28)

(Joins sheet 26)

T. 103 N.

Hokah

Thompson Creek

Butterfield Creek

GERMAN RIDGE

(Joins sheet 34)

2 710 000 FEET

280 000 FEET

285 000 FEET

28

N

R. 4 W. | R. 3 W.

2 725 000 FEET

T. 103 N.

2 715 000 FEET

280 000 FEET

285 000 FEET

(Joins sheet 21)

(Joins sheet 27)

(Joins sheet 35)

UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE

WISCONSIN

MISSISSIPPI RIVER

LA CROSSE COUNTY

Lawrence Lake

WINNEBAGO INDIAN RESERVATION

RESERVATION BOUNDARY

GERMAN RIDGE

CHICAGO MILWAUKEE ST PAUL AND PACIFIC

1016

water

1 2 3 6 10 11 12

N

2 600 000 FEET

R. 7 W.

(Joins sheet 22)

T. 103 N

FILLMORE COUNTY

270 000 FEET

OAK RIDGE

Bridge Creek

18 19 17 20 16 21 15 22

(Joins sheet 30)

(Joins sheet 36)

2 615 000 FEET

265 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 30

30

N

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 31

31

N

R. 6 W.

T. 103 N.

2 640 000 FEET

275 000 FEET

270 000 FEET

2 655 000 FEET

(Joins sheet 24)

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 38)

Badger Creek

Swede Bottom Creek

HALIGE RIDGE

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 32

32

N

R. 6 W. | R. 5 W.

T. 103 N.

(Joins sheet 25)

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 39)

2 670 000 FEET

2 660 000 FEET

275 000 FEET

270 000 FEET

UNION RIDGE

Crystal Creek

13 14 17 18 19 20 23 24

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 33

33

N

R. 5 W.

T. 103 N.

2 675 000 FEET

275 000 FEET

2 690 000 FEET

270 000 FEET

(Joins sheet 26)

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 40)

UNION RIDGE

PEACOCK RIDGE

Thompson Creek

Spring Creek

Spring Creek

16

15

14

13

21

22

23

24

34

N

R. 5 W. | R. 4 W.

(Joins sheet 27)

2 710 000 FEET

275 000 FEET

T. 103 N.

(Joins sheet 33)

270 000 FEET

(Joins sheet 35)

2 695 000 FEET

(Joins sheet 41)

MILLER RIDGE

GERMAN RIDGE

CYPRESS

13 18 17 16 24 19 20 21

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 35

35

N

R. 4 W. (Joins sheet 28)

2 715 000 FEET

T. 103 N.

(Joins sheet 34)

275 000 FEET

Lawrence Lake

MISSISSIPPI RIVER

WISCONSIN

LA CROSSE CO. WIS.

HOUSTON COUNTY

VERNON COUNTY

UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE

CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC

Spring Branch

(Joins sheet 42)

2 725 000 FEET

270 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 36

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 37

37

N

R. 7 W. | R. 6 W.

T. 103 N.

(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 44)

Sheldon

SOUTH FORK ROOT RIVER

Bridge Cr.

Beaver Creek

Beaver Cr.

2 620 000 FEET

2 635 000 FEET

260 000 FEET

255 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 38

(38)

N

(Joins sheet 31)

R. 6 W.

T. 103 N.

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 45)

HAUGE RIDGE

Badger Creek

Sheldon Coulee

Sheldon Creek

2 655 000 FEET

2 640 000 FEET

255 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 39

39

N

R. 6 W. | R. 5 W.

(Joins sheet 32)

2 660 000 FEET

265 000 FEET

T. 103 N.

(Joins sheet 38)

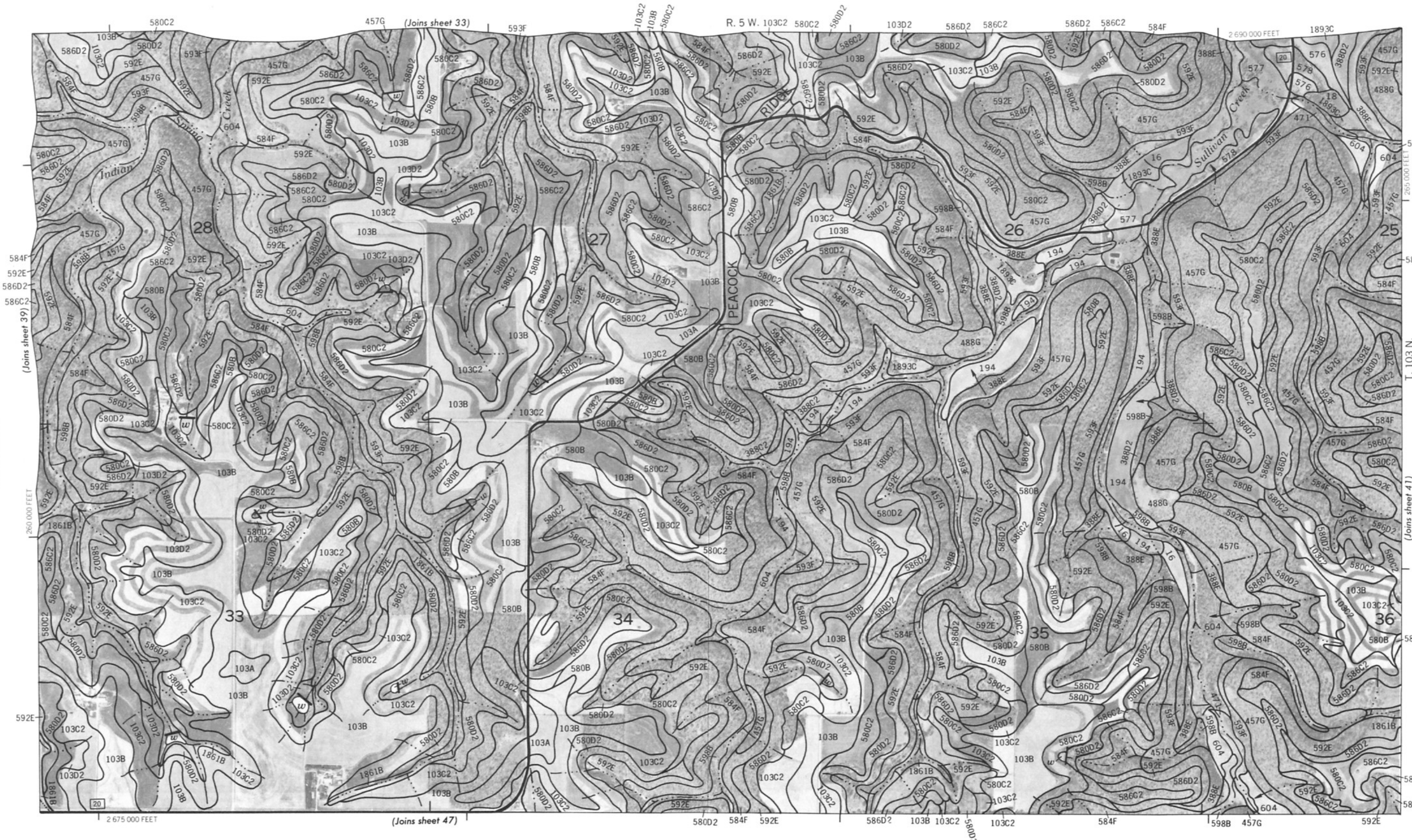
(Joins sheet 40)

260 000 FEET

586D2

2 670 000 FEET

(Joins sheet 46)


40
N
(Joins sheet 33)
R. 5 W.
2 690 000 FEET
265 000 FEET
260 000 FEET
2 675 000 FEET
T. 103 N.
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 47)
Indian Spring Creek
Sullivan Creek
PEACOCK RIDGE
28
27
26
25
33
34
35
36

N

R. 5 W. | R. 4 W.

2 695 000 FEET

T. 103 N.

265 000 FEET

MILLER RIDGE

Wildcat Creek

CORK HOLLOW

25 30 29 28 36 31 23 33

(Joins sheet 34)

(Joins sheet 40)

(Joins sheet 42)

(Joins sheet 48)

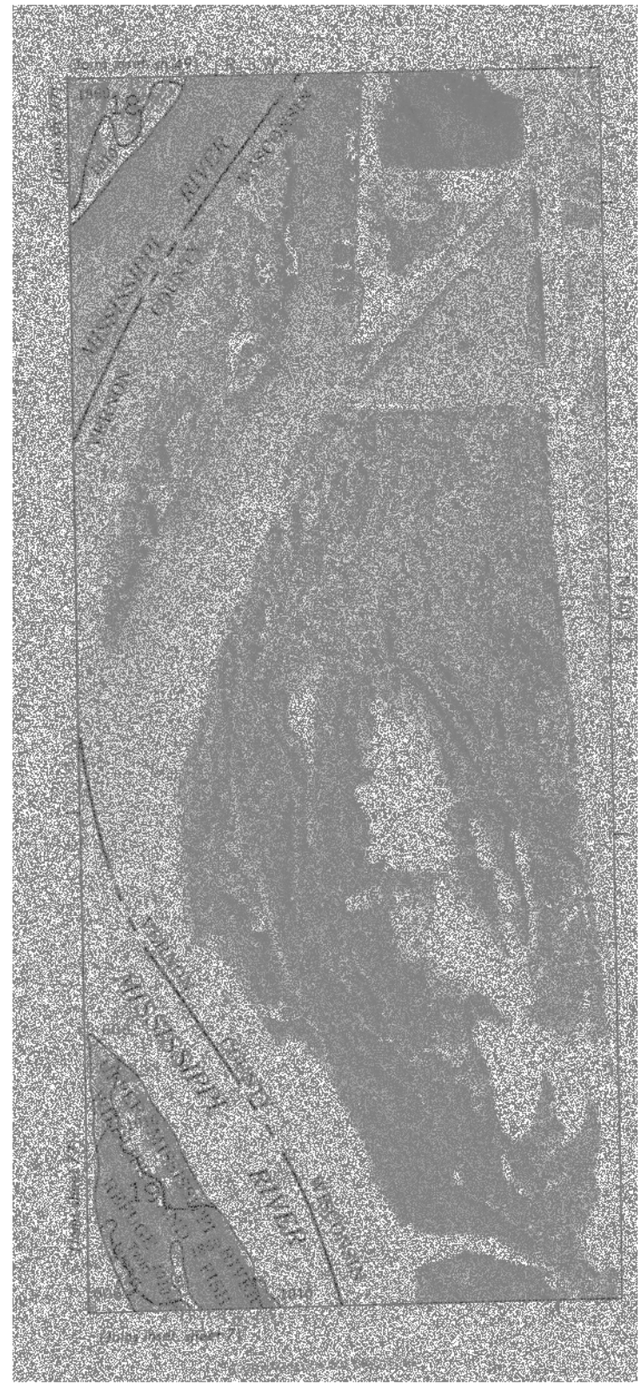
260 000 FEET

2 710 000 FEET

3

N

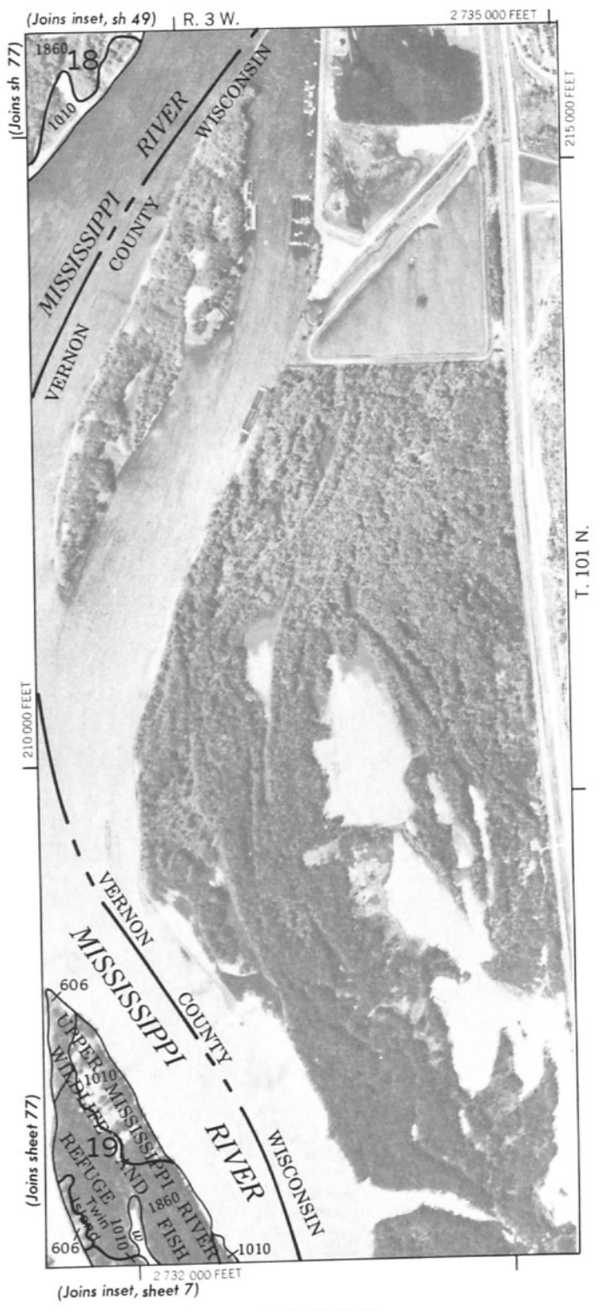
(Joins sheet 41)
(Joins sheet 35)
R. 4 W.
2 720 000 FEET
265 000 FEET
260 000 FEET
2 715 000 FEET
(Joins sheet 49)
T. 103 N.
Brownsville
Wildcat Creek
Bluff Creek
Wildcat Creek
Bluff Creek
Wildcat Creek
Bluff Creek
RIVER
WISCONSIN
MISSISSIPPI
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
MISSISSIPPI RIVER
COUNTY
VERNON
CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC
26
25
27
35
34
16
18
3


MISSISSIPPI RIVER
WISCONSIN
MISSISSIPPI RIVER
(Joins sheet 41)

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 42

42

N



3000 AND 5000-FOOT GRID TICKS

N

R. 7 W.

2 605 000 FEET

250 000 FEET

T. 102 N.

COUNTY

FILLMORE

South Fork Root River

IRISH RIDGE

ROOSTER Ridge

Record Creek

VALLEY

(Joins sheet 36)

(Joins sheet 44)

(Joins sheet 50)

2 615 000 FEET

245 000 FEET

44

N

1 Mile

5 000 Feet

Scale 1:15 840

R. 7 W. | R. 6 W.

T. 102 N.

2 635 000 FEET

255 000 FEET

245 000 FEET

2 620 000 FEET

(Joins sheet 37)

(Joins sheet 43)

(Joins sheet 45)

(Joins sheet 51)

Beaver Creek

West

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 45

45

N

R. 6 W.

T. 102 N.

(Joins sheet 38)

(Joins sheet 44)

(Joins sheet 46)

(Joins sheet 52)

2 640 000 FEET

2 655 000 FEET

255 000 FEET

250 000 FEET

BEAVER CREEK VALLEY STATE PARK

STATE PARK BOUNDARY

Beaver Creek

Beaver Creek East

water

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 46

N

R. 5 W.

2 675 000 FEET

255 000 FEET

T. 102 N.

(Joins sheet 40)

(Joins sheet 48)

(Joins sheet 46)

(Joins sheet 54)

250 000 FEET

2 690 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 48

N

2 715 000 FEET

R. 4 W.

(Joins sheet 42) (26)

255 000 FEET

T. 102 N.

(Joins sheet 48)

VERNON COUNTY

MISSISSIPPI RIVER

WISCONSIN

UPPER

Browns Island

MISSISSIPPI RIVER

WILDLIFE AND FISH REFUGE

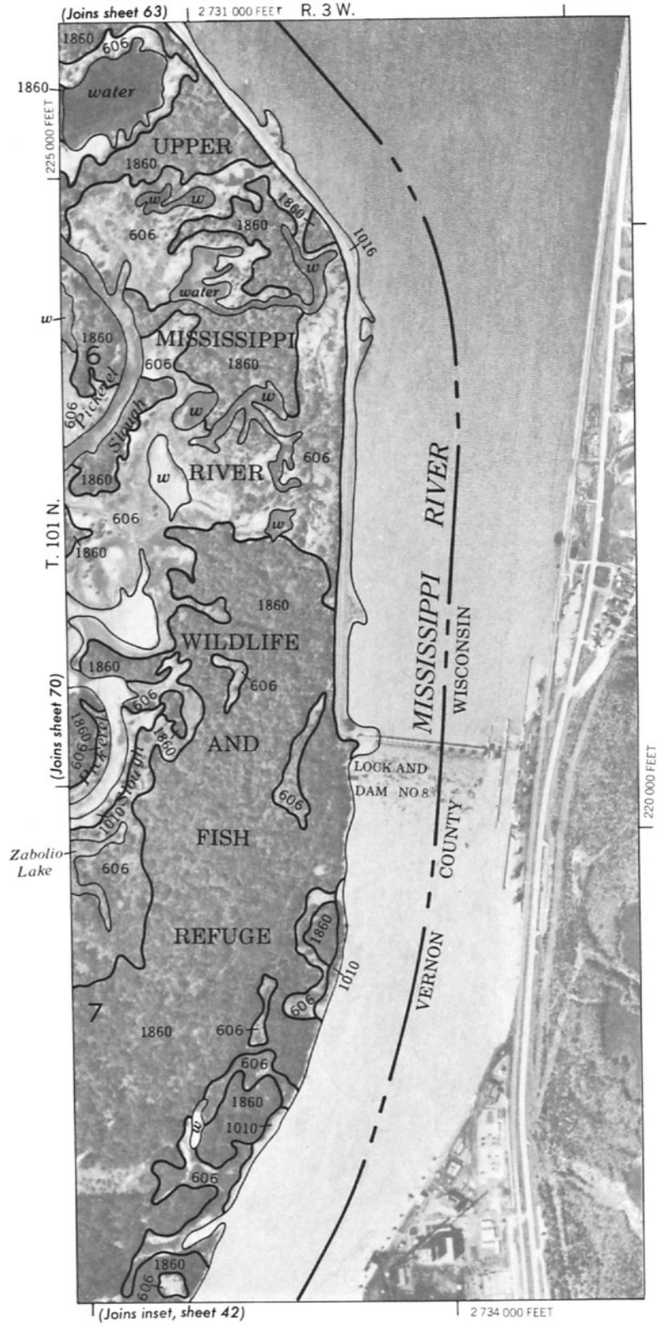
250 000 FEET

(Joins sheet 56)

2 725 000 FEET

3000 AND 5000-FOOT GRID TICKS

N



3000 AND 5000-FOOT GRID TICKS

50

N

(Joins sheet 43)

R. 7 W.

2 615 000 FEET

T. 102 N.

240 000 FEET

(Joins sheet 51)

FILLMORE COUNTY

235 000 FEET

2 605 000 FEET

(Joins sheet 57)

Ricefard Creek

18 17 16 15

19 20 21 22

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 51

51

N

R. 7 W. | R. 6 W.

T. 102 N.

2 620 000 FEET

2 635 000 FEET

240 000 FEET

235 000 FEET

(Joins sheet 44)

(Joins sheet 50)

(Joins sheet 52)

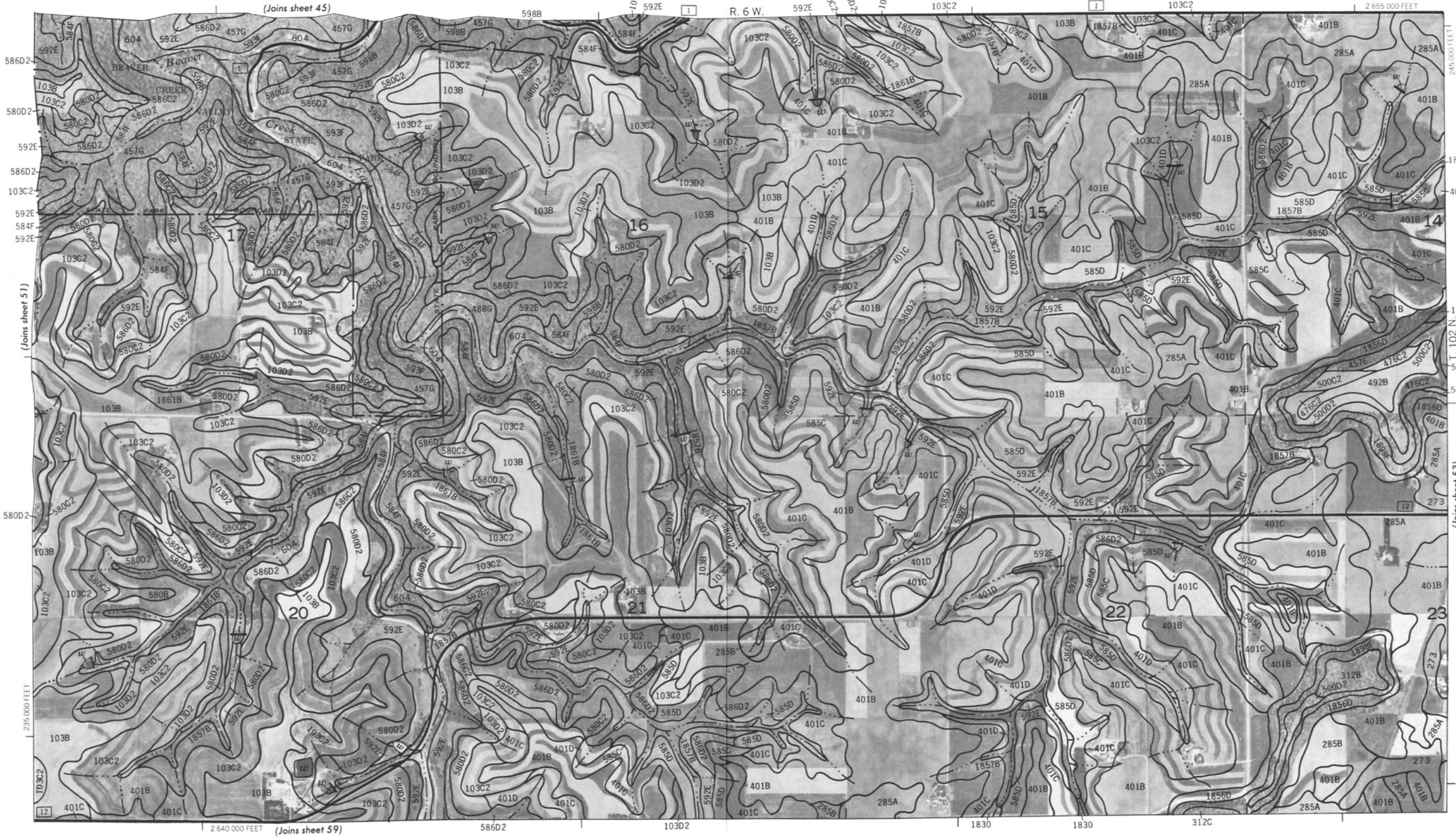
(Joins sheet 58)

Black Hammer

Beaver Creek

52

N


(Joins sheet 45)
R. 6 W.
2 655 000 FEET
245 000 FEET
BEAVER CREEK VALLEY STATE PARK
Beaver Creek
BOUNDARY
16
15
14
17
21
22
23
20
T. 102 N.
(Joins sheet 51)
(Joins sheet 53)
235 000 FEET
2 640 000 FEET
(Joins sheet 59)

N

R. 6 W. | R. 5 W.

2 660 000 FEET

245 000 FEET

T. 102 N.

CALEDONIA
(county seat)

Crooked Creek

North Fork Crooked Creek

MURPHY RIDGE

(Joins sheet 46)

(Joins sheet 54)

(Joins sheet 52)

(Joins sheet 60)

240 000 FEET

2 670 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 54

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 55

55

N

R. 5 W. | R. 4 W.

2 695 000 FEET

245 000 FEET

T. 102 N.

(Joins sheet 48)

(Joins sheet 54)

(Joins sheet 56)

(Joins sheet 62)

240 000 FEET

2 710 000 FEET

13 18 17 16 24 19 20 21

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 56

56

N

R. 4 W.

2 725 000 FEET

(Joins sheet 49)

(Joins sheet 55)

(Joins sheet 63)

2 715 000 FEET

240 000 FEET

245 000 FEET

T. 102 N.

UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE

MISSISSIPPI RIVER

VERNON COUNTY

WISCONSIN

CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC 1016

Fairy Rock

15

14

22

23

24

16

25

26

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 57

57

N

R. 7 W.

(Joins sheet 50)

2 605 000 FEET

T. 102 N.

COUNTY

FILLMORE

230 000 FEET

225 000 FEET

2 615 000 FEET

(Joins sheet 64)

(Joins sheet 58)

Riceford Creek

Black Hammer Bluff

30 29 28 27 31 32 33 34

58

N

(Joins sheet 51)

R. 7 W. | R. 6 W.

2 635 000 FEET

T. 102 N.

230 000 FEET

225 000 FEET

2 620 000 FEET

(Joins sheet 57)

(Joins sheet 59)

(Joins sheet 65)

Black Hammer

West Beaver Creek

27 26 25 30 34 35 36 31

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 59

59

N

R. 6 W.

2 640 000 FEET

2 655 000 FEET

T. 102 N.

230 000 FEET

225 000 FEET

(Joins sheet 52)

(Joins sheet 58)

(Joins sheet 60)

(Joins sheet 66)

29 28 27 26 32 33 34 35

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 60

60

N

(Joins sheet 53)

R. 6 W. | R. 5 W.

2 670 000 FEET

(Joins sheet 59)

(Joins sheet 61)

(Joins sheet 67)

2 660 000 FEET

225 000 FEET

235 000 FEET

T. 102 N.

South Fork Crooked Creek

HOUSTON COUNTY AIRSTRIP

26 25 30 29 35 36 31 32

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 61

61

N

2 675 000 FEET

R. 5 W.

(Joins sheet 54)

235 000 FEET

T. 102 N.

MURPHY RIDGE

South Fork Crooked Creek

South Fork Lake

North Fork Crooked Creek

Crooked Creek

(Joins sheet 60)

(Joins sheet 62)

230 000 FEET

(Joins sheet 68)

2 690 000 FEET

62

N

R. 5 W. | R. 4 W.

T. 102 N.

(Joins sheet 55)

(Joins sheet 61)

(Joins sheet 63)

(Joins sheet 69)

Freeburg

Crooked Creek

water

25 30 29 28 36 31 32 33

2 710 000 FEET

2 695 000 FEET

230 000 FEET

235 000 FEET

N

(Joins sheet 56)

2 715 000 FEET

235 000 FEET

R. 4 W. | R. 3 W.

T. 102 N.

(249)

(Joins sheet 62)

MISSISSIPPI RIVER

VERNON COUNTY

WISCONSIN

230 000 FEET

UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE

Running Slough

Pickerel Slough

Reno

Crooked Creek

Otter Creek

25

26

27

34

35

36

31

(Joins sheet 70)

2 730 000 FEET

(Joins inset, 49)

64

N

(Joins sheet 57)

R. 7 W.

2 615 000 FEET

FILLMORE COUNTY

T. 101 N.

(Joins sheet 65)

(Joins sheet 71)

2 605 000 FEET

220 000 FEET

215 000 FEET

Riceford Creek

Riceford

Creek

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 65

65

N

R. 7 W. | R. 6 W.

T. 101 N.

2 620 000 FEET

220 000 FEET

215 000 FEET

2 635 000 FEET

(Joins sheet 58)

(Joins sheet 66)

(Joins sheet 64)

(Joins sheet 72)

SPRING GROVE

HOUSTON CO. SANITARY LANDFILL

1 2 3 4 5 6 7 8 9 10 11 12

66

N

R. 6 W.

T. 101 N.

(Joins sheet 59)

(Joins sheet 65)

(Joins sheet 67)

(Joins sheet 73)

215 000 FEET

220 000 FEET

2 640 000 FEET

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 67

67

N

R. 6 W. | R. 5 W.

T. 101 N.

2 660 000 FEET

2 675 000 FEET

220 000 FEET

(Joins sheet 60)

(Joins sheet 66)

(Joins sheet 68)

(Joins sheet 74)

Winnebago Creek

Camp Winnebago

N

R. 5 W.

2 690 000 FEET

225 000 FEET

T. 101 N.

(Joins sheet 61)

(Joins sheet 67)

(Joins sheet 69)

(Joins sheet 75)

215 000 FEET

2 680 000 FEET

JEFFERSON RIDGE

1 2 3 4 9 10 11 12

14

401B 103B 103A 103C2 103D2 580C2 580D2 580B 586C2 586D2 584F 592E 598B 457G 488G 1861B 604 194 599E2 593F

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 69

69

N

R. 5 W. | R. 4 W.

2 695 000 FEET

225 000 FEET

T. 101 N.

(Joins sheet 62)

(Joins sheet 68)

(Joins sheet 70)

(Joins sheet 76)

2 710 000 FEET

220 000 FEET

JEFFERSON RIDGE

Clear Creek

1 2 3 4 5 6 7 8 9 10 11 12

70

N

(Joins sheet 63)

2 715 000 FEET

606

R. 4 W. | R. 3 W

(Joins sheet 69)

T. 101 N.

UPPER MISSISSIPPI 1 RIVER WILDLIFE AND FISH REFUGE

Clear Creek

Running Slough

Pickerel Slough

Zabolio Lake

CHICAGO MILWAUKEE ST PAUL AND PACIFIC

2 730 000 FEET

220 000 FEET

(Joins inset, sheet 49)

(Joins sheet 77)

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 71

71

N

R. 7 W.

2 605 000 FEET

2 620 000 FEET

210 000 FEET

205 000 FEET

T. 101 N.

COUNTY

FILLMORE

Riceford Creek

Riceford Creek

(Joins sheet 64)

(Joins sheet 72)

(Joins sheet 78)

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 72

72

N

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 73

73

N

R. 6 W.

T. 101 N.

PRAIRIE PORTLAND

Wilmington

(Joins sheet 66)

(Joins sheet 72)

(Joins sheet 74)

(Joins sheet 80)

2,640,000 FEET

2,655,000 FEET

210,000 FEET

205,000 FEET

74

N

R. 6 W. | R. 5 W.

(Joins sheet 67)

(Joins sheet 73)

(Joins sheet 75)

(Joins sheet 81)

T. 101 N.

2 675 000 FEET

2 660 000 FEET

205 000 FEET

210 000 FEET

PORTLAND PRAIRIE

CABBAGE RIDGE

Winnebago Creek

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 75

75

N

R. 5 W.

T. 101 N.

2 680 000 FEET

2 690 000 FEET

210 000 FEET

205 000 FEET

Wimmebago Creek

CABBAGE RIDGE

(Joins sheet 74)

(Joins sheet 76)

(Joins sheet 68)

(Joins sheet 82)

(76)

N

R. 5 W. | R. 4 W.

(Joins sheet 69)

(Joins sheet 75)

(Joins sheet 77)

(Joins sheet 83)

T. 101 N.

2 710 000 FEET

2 695 000 FEET

215 000 FEET

205 000 FEET

13 18 17 16 24 19 20 21 16

5 14

N

215 000 FEET

2 715 000 FEET

T. 101 N.

R. 4 W. | R. 3 W.

(Joins sheet 70)

(Joins sheet 76)

(Joins sheet 84)

UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE

MISSISSIPPI RIVER

CO. WIS.

VERNON

210 000 FEET

2 730 000 FEET

Hayshore Lake

Ice Haul Slough

Dark Slough

PACIFIC

ST PAUL

MILWAUKEE

CHICAGO

water

13 14 15 18 19 22 23 24 26

78

N

(Joins sheet 71)

R. 7 W.

2 620 000 FEET

200 000 FEET

T. 101 N.

(Joins sheet 79)

195 000 FEET

COUNTY

FILLMORE

2 605 000 FEET

WINNESHIEK COUNTY IOWA

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 79

79

N

R. 7 W. | R. 6 W.

(Joins sheet 72)

(Joins sheet 78)

(Joins sheet 80)

T. 101 N.

2 625 000 FEET

2 635 000 FEET

195 000 FEET

200 000 FEET

Bear Creek

Bear Creek

WINNESHIEK COUNTY IOWA

ALLAMAKEE COUNTY IOWA

N

R. 6 W.

T. 101 N.

(Joins sheet 73)

(Joins sheet 79)

(Joins sheet 81)

2 655 000 FEET

2 640 000 FEET

200 000 FEET

195 000 FEET

ALLAMAKEE COUNTY IOWA

Bee Creek

Duck C.

Bee

584F 1016 27 1857B 585D

285B 103C2 585D 1857B 580C2 592E 593F 103C2 580C2 401B 401C 285B 103B 103C2 103D2 584F 580C2 401B 592E 457G 301B 604 103C2 457G 598B 580D2 584F 103C2 103B 585C 584F 592E 580D2 103D2 103C2 401B 285A 580D2 1857B 103C2 401B 586C2 592E 580D2 103D2 457G 592E 580D2 103D2 586D2 401D 586D2 1857B 103C2 401B 285A 103B 593F 584F 301C 592E 586D2 457G 103D2 16 401B 103C2 580C2 586D2 584F 580C2 103B 103D2 103C2 1857B 585C 301C 592E 586D2 457G 103D2 16 401B 285A 586D2 584F 580C2 103B 103D2 103C2 1857B 585C 580D2 103B 586D2 580C2 103C2 1857B 585C 301B 285B 401B 103C2 592E 580C2 586D2 103B 580D2 584F 103C2 586D2 580C2 592E 103D2 103C2 580C2 592E 103C2 580C2 586D2 592E 103C2 580C2 586D2 592E 103C2 580C2 586D

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 81

81

N

R. 6 W. | R. 5 W.

2 660 000 FEET

2 675 000 FEET

200 000 FEET

195 000 FEET

T. 101 N.

PORTLAND PRAIRIE

(Joins sheet 74)

(Joins sheet 80)

(Joins sheet 82)

26 25 30 29 35 36 31 32

Duck Creek

Duck Cr.

Fitzen

ALLAMAKEE COUNTY IOWA

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 82

82

N

R. 5 W.

T. 101 N.

2 690 000 FEET

195 000 FEET

200 000 FEET

(Joins sheet 75)

(Joins sheet 81)

(Joins sheet 83)

ALLAMAKEE COUNTY IOWA

RIDGE

SQUARE

DOG

HOLLOW

NEW YORKER

HOUSTON COUNTY, MINNESOTA — SHEET NUMBER 83

83

N

2 695 000 FEET

R. 5 W. | R. 4 W.

T. 101 N.

200 000 FEET

(Joins sheet 82)

(Joins sheet 76)

(Joins sheet 84)

195 000 FEET

2 710 000 FEET

Winnebago Creek

25 30 29 28 36 31 32 33

ALLAMAKEE COUNTY IOWA

84

N

(Joins sheet 77)

(Joins sheet 83)

R. 4 W. | R. 3 W.

2 730 000 FEET

2 705 000 FEET

2 715 000 FEET

2 695 000 FEET

T. 101 N.

(Joins inset, sheet 7)

ALLAMAKEE COUNTY IOWA

UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE

Twin Bluffs

Ice Haul Slough

Mud Lake

Mud Lake

Goose Lake

Sand Slough

Minnesota Slough

Winnebago Creek

Winnebago Creek

Slough

Pigeon Slough

Indian Slough

CHICAGO MILWAUKEE ST. PAUL AND PACIFIC 1016

25 26 27 30 31 34 35 36